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# *The* CANADIAN FIELD-NATURALIST

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Volume 67

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1953



*Published by*  
THE OTTAWA FIELD-NATURALISTS' CLUB

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# The CANADIAN FIELD-NATURALIST

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*Published by the*

**OTTAWA FIELD-NATURALIST' CLUB**

*Entered at the Post Office at Ottawa, Ont., as second class matter.*

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*Price of this volume (4 numbers) \$3.00; Single copies 90c each.*

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Subscription (\$3.00 per year) should be forwarded to DR. R. J. MOORE,

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# The Canadian Field-Naturalist

Vol. 67

OTTAWA, CANADA, JANUARY-MARCH, 1953

No. 1

## A BRIEF STUDY OF THE DOUBLE-CRESTED CORMORANT ON LAKE WINNIPEGOSIS<sup>1</sup>

J. A. McLEOD and G. F. BONDAR

JUN 12 1953

*Game and Fisheries Branch, Province of Manitoba*

THE STATUS of the Double-crested Cormorant, *Phalacrocorax auritus auritus* (Lesson), in relation to the destruction of commercial fishes has been the subject of considerable controversy in parts of Manitoba within recent years. It is generally agreed that this predaceous bird lives almost exclusively on fish and, also, that it frequently kills more than it consumes. However, there was considerable doubt as to the species of fish destroyed in local waters and the actual amount taken per season. If this bird were found to consume only coarse, unmarketable fish it might benefit the industry in so doing, but if it destroyed commercial fishes or the forage fishes of commercial species, then its presence in appreciable numbers is to be viewed with concern.

The area principally affected was Lake Winnipegosis and in response to many complaints from local fishermen the investigation reported on herein was initiated by the Game and Fisheries Branch, Province of Manitoba, in 1943. It had as its objectives the following:

1. To determine what percentage of the diet of cormorants in this breeding area was composed of commercially important fish species.
2. To determine what was the per diem consumption of fish for each bird present.
3. To determine the number of cormorants utilizing the area as a nesting ground and the rate at which they were reproducing.
4. If the existing population was found to be excessive, to determine whether or not natural mortality could be depended upon to reduce the excess and, if not, what artificial means could best be applied.

That the Double-crested Cormorant is widely scattered over the Mid-west during

the breeding season is attested to by the observations of Cartwright (1931), DuMont (1934), Lundquist (1932), Marsh (1934), Munro (1927), Ormand (1947), Smith (1911) and many others. To what extent these birds have been utilizing Manitoba lakes as feeding and breeding grounds has not been completely investigated but known populations recorded by Mendall (1936) are shown in Table 1.

Just what the nesting population of this bird is at present on Lake Winnipeg is not known. Similarly, Lake Manitoba has not been fully investigated recently, but undoubtedly there are several nesting colonies present each year. A group of about 200 individuals was seen from an aircraft by one of us (McLeod) in July of 1945 near Garden Island at the north end of the Lake. The birds were engaged in fishing but where their nesting area was located was not determined. During 1949 and again in 1950 a small colony with about 25 nests occupied a reef about one-half mile off the south shore of Lake Manitoba near St. Ambroise. However, it was not reoccupied in 1951.

In 1941 one of the writers (McLeod) observed a colony of 65 nests on a large emergent rock in Crow Duck Lake in the Whiteshell area. By 1944, when next seen, two additional rocks had been occupied and a total of 112 nests was present. Two small, very bare rocky islands close to the north shore of Lake Atikameg were seen to harbor nesting colonies in 1944. One island had about 200 nests and the other, which appeared to have been occupied more recently, had about 150 nests. Although the writers have visited a great many of the smaller Manitoba lakes in recent years, apart from Lake Winnipegosis, no nesting sites have been found other than those mentioned.

<sup>1</sup>) Received for publication March 17, 1952.



Table 1.—Manitoba populations of Double-crested Cormorant as recorded by Mendall (1936)

Colony	Date observed	Observed by	Publication	Population
Lake Manitoba (10 colonies)	1927	Munro	Munro (1927)	1012
Pipestone Rocks (L. Winnipeg)	1928 1935	Cartwright Rogers	Lewis (1929) Unpublished	650 128
Reef near Commissioner I. (L. Wpg.)	1935	Rogers	Unpublished	38
Reef near Nut I. (L. Wpg.)	1935	Rogers	Unpublished	138
Reef near Egg I. (L. Wpg.)	1935	Rogers	Unpublished	66
Reefs near George I. (L. Wpg.)	1931	Bajkov	Cartwright (1931)	2000 (?)
Lake Winnipegosis (5 colonies)	1913	Bent	Bent (1922)	4090
Chitek Lake (Several col.)	1929	MacFarlane	Lewis (1931)	300 (?)
Pelican River	1928(?)	Reid	Lewis (1931)	200
Herb Lake (Several col.)	1930	Wright	Lewis (1931)	200
Cedar Lake	1928	MacDonald	Lewis (1929)	500

In 1943 it was possible to visit only four of the larger occupied reefs which were located near the north end of Lake Winnipegosis. Again in 1944 three of these sites were visited during the nesting season. By 1945 it was possible to obtain a larger boat by means of which the entire lake was covered and all reefs which had been or presently were being used as nesting sites were visited. In 1950 and again in 1951 these reefs were examined from aircraft and in the majority of cases, if they were occupied, a landing was made. In some cases where a relatively few nests were present, nest counts were made by means of aerial photographs taken with a Busch Pressman camera using an exposure of 1/500 sec.

#### Physical Features

Lake Winnipegosis is a large, irregular body of water with a length of about 125 miles and a maximum width of about 22 miles (Fig. 1.). It is quite shallow with a

reported maximum depth of 32 feet and has a great many islands of various sizes and ages as well as numerous recently emerged reefs. The water level fluctuates considerably from year to year and there is a corresponding variation in the size and shape of the islands and reefs, some of the latter disappearing entirely at times of high water. Like the shore, the islands are low and flat and are timbered to a considerable extent, the predominant type being black spruce (*Picea mariana*). It is one of the relict portions of the extinct Lake Agassiz.

Lake Winnipegosis is fed mainly by numerous sizable streams draining the slopes of the Duck and Porcupine Mountains and empties out through the Waterhen River into Lake Manitoba. It is a heavy producer of fish, mainly of the anadromous type. The only nesting sites found during the investigation were on relatively small, partially or completely bare reefs. Reefs and islands bearing woody plants were not utilized and

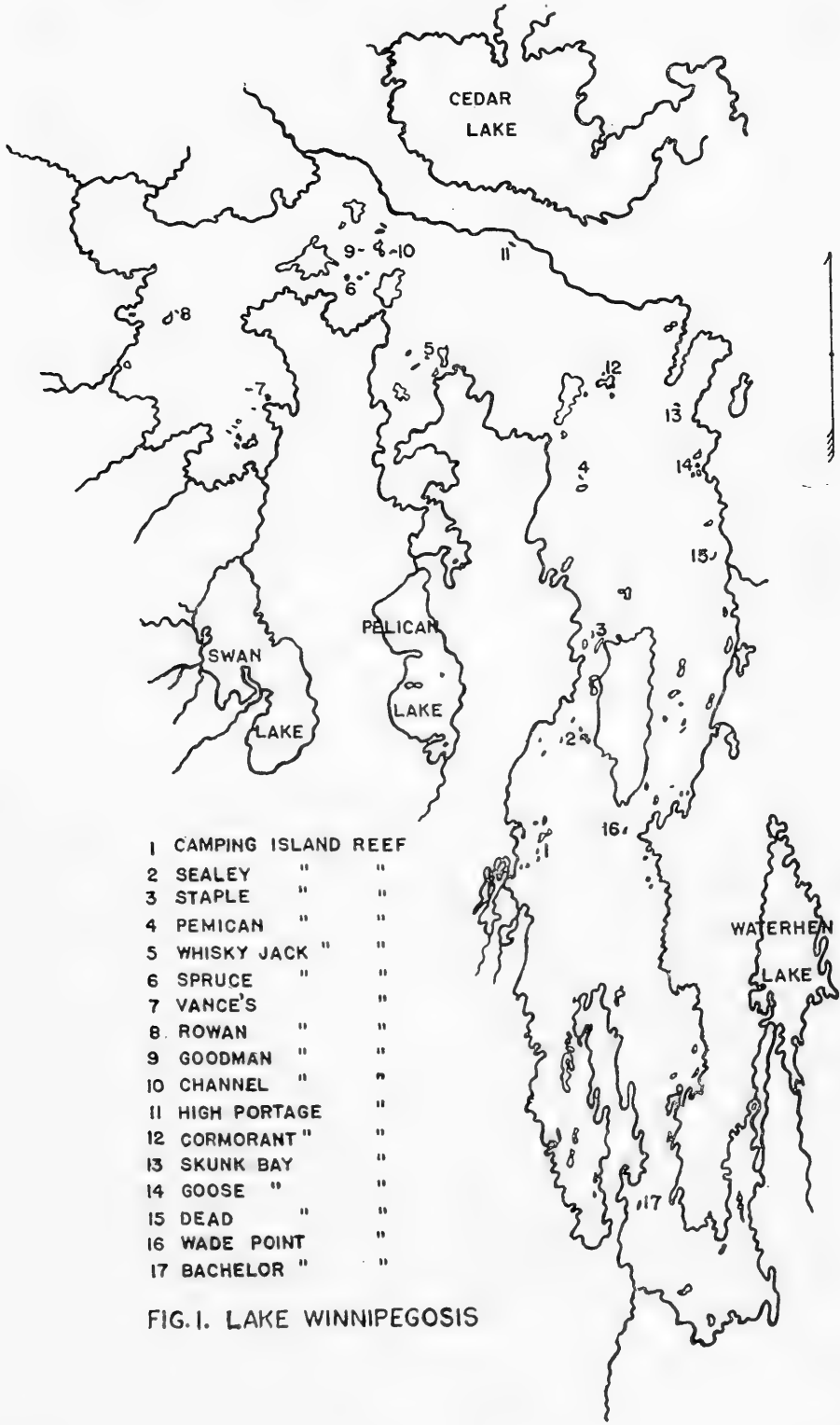


FIG.1. LAKE WINNIPEGOSIS

no nests were found on the mainland although a local report stated that a tree-nesting colony had existed near Pelican Bay some twenty years before.

### **Vegetation in Relation to Nesting Area**

Many of the reefs are recently formed ridges of gravel and boulders pushed up by ice action (Fig. 2). Others are of a similar type but the receding waters have left stretches of exposed lake bottom surrounding the original ridge. On the very recent or the extremely rocky or gravelly ones vegetation is frequently lacking, but where the lake bottom has been exposed for any length of time coarse grasses such as foxtail (*Alopecurus* sp.) are usually present. In the area immediately occupied by nests and for fifteen or more feet around the edge, vegetation was absent. This was due, in part, to trampling but largely because of the high content of nitrogen, calcium, phosphorus, etc., of the guano which in some places had accumulated to a depth of 28 inches. Around the edges and in abandoned nesting areas where leaching had removed much of the above-mentioned substances there was found a dense growth of nettles (*Urtica* sp.) with occasional stands of giant ragweed (*Ambrosia* sp.) and lamb's quarter (*Chenopodium* sp.). These are rather short at first but later become very luxuriant (Fig. 3).

### **Nests and Adults**

The nests were found to be closely packed together in all cases and in the several areas measured they averaged one per square yard. (See Fig. 3). Only on rare occasions was a nest found more than ten feet from its nearest neighbor. The centre of the area always appeared to be the choicest site as it contained the tallest and oldest nests. Nest building and egg laying appears to not always be synchronous over the area as, in some cases, very flat nests with no eggs or incomplete clutches were found around the periphery when young of several days of age were present in the central portion. Similarly, considerable differences in the time of nesting occur from one reef to another with some showing egg laying only partially completed while others contain a high proportion of young.

Judging by the accumulated guano, those showing later nesting were reefs which were presently being occupied for the first time or had been occupied only in relatively recent

years. Whether the nesting individuals represented mostly young birds or ones whose nesting operations elsewhere had been disturbed was not known.

Nests for the most part were constructed of dry stalks of nettles or ragweed if such were present. In a few cases green nettle stalks with leaves were used in the construction of shallow nests around the periphery when dry material was not available. On reefs completely devoid of vegetation, nests were often little more than depressions in the ground but occasionally ragweed stalks, old fish net, gull feathers and assorted other materials had been transported for some distance. In the nesting area the substratum was usually composed of smoothly trampled guano, decaying fish remains, carcasses of dead birds, etc.

During the investigation it was realized that any attempt to count adult birds would be futile so the method of Lewis (1929) was adopted for calculating the number of adults present. Here nests were counted and since the birds are monogamous a doubling of this number would give an approximation of the breeding individuals. However, it has been suggested by others that approximately one-half of the specimens of previous years in a colony are non-breeding juveniles. This was considered to hold true in the present work and consequently a correction factor of 4 has been applied to the nest count in arriving at a rough estimate of the number of adults present.

The following is a brief summary of the history of each past and present rookery (see Fig. 1.):

#### **1. Camping Island Reef.**

A small, gravel and boulder reef with vegetation confined to a few tufts of nettles not over six inches high. It appeared to have been occupied for only a few years prior to 1945 when 90 nests were present. It was unoccupied in 1950 and again in 1951. A moderate number of herring gulls (*Larus argentatus*) and common terns (*Sterna hirundo*) were found nesting here in 1945.

#### **2. Sealey Island Reef.**

A reef of recent origin about one-half mile long by a maximum of 25 yards in width. There were indications of recent occupation in 1945 but has remained vacant. A large number of tern nests were present.

#### **3. Staple Island Reef.**

A boulder reef with a length of one-quarter of a mile by 25 yards in width. A

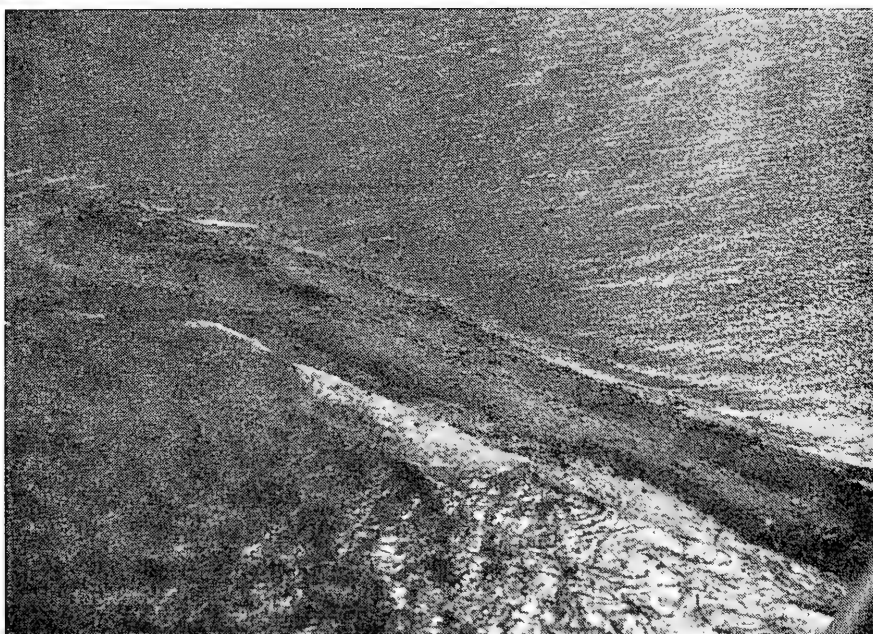


Figure 2. Rowan Island reef, a recently formed reef of gravel and boulders with a small nesting colony of cormorants at the distal end.



Figure 3. Cormorant Island reef taken from directly above. The nesting area occupies the left two-thirds of the reef while the right one-third is occupied by vegetation, there being a sharp line of demarcation between the two. The white objects are flying gulls, terns and pelicans.

Table 2. — Comparison of Nests, 1943 to 1951

Reef	July 6-12 1943	July 11-15 1944	June 20-27 1945	July 14 1950	June 27 1951
1. Camping I.	—	—	90	0	10
2. Sealey I.	—	—	0	0	0
3. Staple I.	—	—	0	0	0
4. Pemican I.	—	—	1056	0	0
5. Whisky Jack I.	2100	961	943	115	100
6. Spruce I.	5292	3572	3633	3245	2151
7. Vance's I.	—	—	600	40	30
8. Rowan I.	460	97	177	340	226
9. Goodman I.	—	—	0	0	0
10. Channel I.	—	—	0	0	0
11. High Portage	—	—	52	0	0
12. Cormorant I.	1137	—	1617	1819	1939
13. Skunk Bay	—	—	430	40	0
14. Goose Bay	—	—	714	150	0
15. Dead I.	—	—	0	0	0
16. Wade Point	—	—	289	0	0
17. Bachelor I.	—	—	261	200	200
Total nests	—	—	9,862	5,949	4,656
Estimated total adults	—	—	39,448	23,796	18,624

high, rocky mid-portion bore several inches of well-matured guano over an area which appeared to have accommodated about 1,000 nests. It has been vacant for several years and has a good growth of raspberry and gooseberry bushes.

#### 4. Pemican Island Reef.

A rocky reef which appeared to have been occupied for some time and in 1945 had 1,656 nests. It was vacant in 1950 and in 1951.

#### 5. Whisky Jack Island Reef.

A rocky reef about 300 yards in length by a maximum width of 50 yards. It is composed of three equal parts connected by boulders over which the waves wash. The central portion, comprising the nesting area contained 2,100 nests when visited in 1943 but these had been reduced to 100 by 1951.

#### 6. Spruce Island Reef.

A long, low reef containing about five acres, the larger portion of which is composed of exposed lake bottom supporting a growth of short grass. The nesting area varied considerably in shape and position from year to year but was always confined to a rocky ridge down the middle. Nests were reduced from a total of 5,292 in 1943 to 2,151 in 1951. The nesting terns, gulls

and pelicans increased progressively in this area through the years. Nesting pelicans increased from 6 in 1943 to about 60 in 1951. In some cases the nesting areas of the pelicans and cormorants were confluent.

#### 7. Vance's Reef.

A high, gravel and boulder reef about 100 yards long by 15 yards in maximum width. From the amount of guano present in 1945 it appeared to have been occupied for only one or two years. The 600 nests of 1945 had dropped to 10 in 1951. Many Caspian Tern nests were present on one end of the reef in 1945.

#### 8. Rowan Island Reef.

Very similar in size and appearance to the previous one. It appeared to have been occupied first only a short time prior to 1943. The nest count dropped from 460 to 97 and then rose again to 226 in 1951.

#### 9. Goodman Island Reef.

A high, narrow reef about 600 yards long by a maximum width of 50 yards. The nesting area occurred on a high portion and was large enough to have accommodated about 1,500 nests but had not been occupied for at least three or four years when seen in 1945 as it was densely grown over with nettles and

ragweed. Apparently it had been utilized for many seasons as the old guano completely covered large boulders.

#### 10. Channel Island Reef.

Very similar to the previous one in physical features. It also showed evidence of having been occupied by about 1,500 nests for about the same time. It had been abandoned for a few years.

#### 11. High Portage Reef.

A low, gravelly reef about 200 yards long by 25 yards in maximum width. In 1945 it appeared to have been taken over as a nesting area quite recently and only 52 nests were present. No vegetation was present on the reef and nests were made of gull feathers, old fish net and water-borne debris. A rise in water level had completely eliminated the reef in 1950 and 1951.

#### 12. Cormorant Island Reef.

A broad, irregular reef containing about two acres, a portion of which had been occupied for many years. The nests increased progressively here from 1,137 in 1943 to 1,949 in 1951.

#### 13. Skunk Bay Reef.

A high, narrow reef about 300 yards long and apparently of some age as it bore some grass and herbs. The 430 nests present in 1945 occupied the higher, central portion of the reef and represented a part of what appeared to have been a large nesting area in past years as old guano, overgrown by nettles, etc., extended over a large patch. The number of nests dropped from 430 in 1945 to zero in 1951. Reports received in 1945 stated that the eggs had been broken consistently by lumbermen from a camp nearby on the mainland. On June 25, 1945, the nests were in good repair but were totally without eggs. An earlier laying of eggs was reported to have been broken and it appeared the birds were preparing to lay a second time.

#### 14. Goose Island Reef.

A high, narrow reef of medium size. The 714 nests seen in 1945 were reduced to 150 in 1950 and in 1951 the area was vacant. In 1945 there was considerable evidence that the reef had also been visited by lumbermen from the mainland and the eggs broken earlier that season and on at least two previous years.

#### 15. Dead Island Reef.

An irregular, low reef about half a mile in length with a rocky, crescent-shaped ridge about 100 yards in length near the east end.

There was an abundance of old guano on this portion indicating that up to 1,500 nests might have been present at one time a few years before. However, the reef remained vacant during the years of observation.

#### 16. Wade Point Reef.

A narrow reef of moderately recent origin which appeared to have been occupied for a few seasons prior to 1945. On June 26, 1945, when visited, this reef had a total of 289 nests, all but ten of which contained eggs. Seventeen days earlier a party of fishermen had visited this reef and broken all the existing eggs but, obviously, renesting was taking place. Whether or not it was again occupied in the years immediately following is not known but it was vacant in 1950 and again in 1951.

#### 17. Bachelor Island Reef.

A small, oval reef of about 20 feet in maximum height, composed mainly of coarse boulders. Local reports stated that the population of nesting birds had not changed appreciably in the five years prior to 1945 although a mink rancher harvested the young each year for mink food. There were 261 nests present in 1945 and an estimated 200 in 1950 and again in 1951.

### Food Consumption

Throughout the investigation attempts were made to determine the composition of the birds' diet and the quantity of each species of organism consumed. Very few adult birds were collected for stomach examination and estimates were based mainly on the weight and composition of regurgitated boli of material left by the adults. It was found that if disturbed soon after arriving with a fresh load of food for the young, the adults would usually regurgitate the stomach contents before taking off. The solid portion of this was then collected over an area occupied by a known number of nests and young.

Such a method is of little value in arriving at the total consumption per bird per day as it was impossible to determine definitely how many loads were brought in during a day or to compute the weight of the parts already digested. On an undisturbed nesting area where young were present, flights appeared to return at approximately hourly intervals, but it is doubtful if all birds returned with more than one load in the morning and another in the afternoon. As might be expected, there was a definite correlation be-

tween the number and size of the young present and the amount of food brought.

Eight half-grown young cormorants were collected in 1950 for the purpose of carrying out feeding experiments but they failed to survive the long trip to the laboratory. The observations of others such as Lewis (1929) and Wetmore (1927) set the amount of food for active or growing birds of medium age at from three-quarters to one pound per day. Poultry authorities assure us that, on the basis of the body weight of the birds and the food content of fish, this should be an accurate estimate.

As pointed out by Lewis, young under the age of about one week are unable to utilize unaltered fish tissue. To provide members of this age group with food the parent birds apparently retain the fish tissue in the stomach for a longer period until digestion has progressed. On several occasions the parent bird of young of only a couple of days was driven off but before taking flight it regurgitated a stream of semifluid, milky appearing material. On close examination this proved to be a watery suspension of fish muscle in which the individual fibers were mostly separated. There was no evidence of the production of anything comparable to "pigeon milk" but the possibility might bear investigation.

The types of material found in regurgitated boli are as follows:

Tullibee (*Leucichthys* sp.)  
Minnows (various species)  
Darters (*Boleosoma nigrum*)  
Suckers (*Catostomus commersonii*)  
Perch (*Perca flavescens*)  
Pickerel (*Stizostedion vitreum*)  
Marias (*Lota lota maculosa*)  
Stickleback (*Eucalia inconstans*)  
Goldeyes (*Amphiodon alosoides*)  
Crayfish (*Cambarus* sp.)

The morning collections contained larger fish almost exclusively while a majority of small species and crayfish was found in afternoon collections. Tullibee and perch made up 55.7% and 31.3% by weight of all the material checked. Pickerel made up 6.5% and goldeyes 0.7% of the material brought in. The latter two are the only species of particular commercial value at present and represent a total of 7.2% or a relatively small portion of the total consumption.

## Reproduction

No records are available as to when Manitoba cormorants first begin the season's egg laying but, based on the study of stages of incubation of eggs and the ages of young, it would seem to be about the middle of May on an average year. However, the laying season is considerably drawn out by what appear to be younger birds nesting around the periphery of an area or in a new area who begin egg laying as late as July 1. There is no evidence that local cormorants normally produce two broods per season, but the following information indicates strongly that if the first attempt is unsuccessful and the season not too advanced, a second attempt is made by the majority of birds. On June 20, 1945, when visited, the rookery on Whisky Jack Island reef contained a total of 943 occupied nests, in about 20% of which the eggs had hatched within the previous five days. All eggs and young were destroyed but when visited again on July 13, 495 nests had been rebuilt. Of these, 130 had two eggs each and the remainder had three eggs each. Similarly, in 1945, the Cormorant Island rookery had 1,617 nests with eggs, young or both which were completely destroyed on June 24. When visited again on July 26th, there were 643 rebuilt nests present, about equal portions containing two eggs each and one egg each.

Counts of several hundred presumably complete clutches of eggs gave an average of 2.43 eggs per nest in 1943, 2.87 in 1944 and 3.63 in 1945. Taken over the years about three eggs per clutch appears to be a reasonable average, although four or five eggs per nest are common and as high as nine have been observed. This is thought to represent the clutches of two females, however.

## Mortality

Mortality among the eggs or young of cormorants in Manitoba from non-human causes appears to be very low and few infertile or broken eggs are normally found. The early portion of the nesting season of 1950 was accompanied by cold, stormy weather and a much higher percentage of spoiled eggs was found. These may have resulted from earlier human interference as it was not possible to determine the cause in every case, but, at most, the loss was almost negligible. Mammalian predators were entirely absent from the reefs and, while both Herring and Ring-



billed Gulls were present in abundance they did not attack the unmolested eggs or the young as noted by Mendall. On one occasion when a large number of eggs had been broken and young killed the remains of the eggs were immediately consumed by large numbers of Ring-billed Gulls which congregated there. Only occasionally was part of the body of a dead young cormorant consumed.

On frequent occasions the reef was found to be shared by the cormorants with nesting Common and Caspian Terns, Herring and Ring-billed Gulls, and Pelicans. Pelicans were the only species whose nests intermingled with those of the cormorants, in part, or were in the immediate vicinity. While scavenging activity on the part of the other species was usually pronounced no direct evidence of predation was seen.

There appeared to be little or no loss of young from cold or storms although local nests are well exposed and Mendall stated that young are very susceptible to cold. Contrary to the report of Mendall the young were found to be very susceptible to intense sunshine. On June 26, 1945, the mid-day temperature on Spruce Island reef was around 90 degrees F. and the sun was extremely bright. Young of all ages up to about three weeks were present and our presence prevented the adults from shading them. Those with the least pigment or protective down died in less than twenty minutes while forty minutes exposure was sufficient to kill them all. Young pelicans of comparable ages but lacking pigment succumbed even sooner than the cormorants. The symptoms were essentially those of heliopathia with disturbed equilibrium, coma and death. The low humidity of the area would permit the passage of intense actinic radiation. The low elevation of the nesting reefs reduced the loss from falls over cliffs, etc., to zero.

All the colonies observed appeared to be enjoying an abundance of food and no definite trace of disease was seen. The few adult specimens available for post-mortem examination yielded a small number of nematodes tentatively identified as *Contra-caecum spiculigerum*. Mallophagan parasites were quite abundant on the outer body surface and in the buccal cavity where they appeared to be doing little harm. All those examined were tentatively identified as *Tetraphthalmus incompositus*.

### Economic Status

Information gathered from personal observations and from local fishermen indicated that the Double-crested Cormorant had been increasing quite rapidly on Lake Winnipegosis up to 1943. Whether this was due to highly successful reproduction and survival locally or to the immigration of nesting birds from elsewhere is not known but probably both were involved. However, Bent's figures (1922) for this lake may not have been complete and many of the birds reported by Lawrence (1931) might have nested in this area rather than Lake Winnipeg. The abandonment of the large nesting areas listed earlier might be taken to mean that a very large population had been present in previous years.

However, regardless of past abundance, the population in 1943 of birds of one or more years of age on four large reefs was estimated to be 35,956. There were also present 8,989 nests containing 12,977 eggs and 8,155 young. Allowing a 5% mortality in eggs and young this would give an estimated total population by the end of the breeding season of 48,031.

In 1944 there was present on three of the same reefs a total of 4,630 nests with 13,288 young or eggs and an estimated population of adults of about 18,520. At the end of the season this would have given an estimated total population of birds of 31,144 on the three reefs. Again in 1945 there was found on all the occupied reefs a total of 9,862 nests representing about 39,448 adult birds and a potential at the end of the season of 75,247 birds.

At an average daily consumption of fish per day of one pound for each bird, which appears to be a reasonable estimate in view of the findings of Mattingly (1927), and Wetmore (1927) as well as those already mentioned, the daily food requirement would amount to approximately 37 tons. Even though the percentage of commercial species taken was much less than the 30 to 35% found by Ormand (1947) and several other investigators in various areas, it would still amount to a calculated 2.66 tons per day.

### Control

The cormorant population of the area appeared to be excessive under existing conditions and attempts were made to bring the birds under control without threatening their extinction. To what extent earlier

control measures had been applied or had been effective the writers were unable to determine. Certainly the eggs and young had been destroyed sporadically by fishermen for many years. During our visits to the rookeries in 1943, 1944 and 1945 at the height of the breeding season all eggs and young were destroyed.

A recheck of the effectiveness of this procedure on two occasions showed that at least 30% to 50% of the pairs had renested. How successful the attempts at the late season would be is not known but a considerable portion, if not all, the young would be large enough to make the fall migration.

It was decided in 1951 that the killing of the embryos without egg destruction as mentioned by Goss (1944) would prolong the brooding period and remove the stimulus to lay a second time, thus forming a much easier and more effective method of control. The writers were aware that dipping the eggs in plasting solution as practised in Ontario (personal correspondence between Mr. G. E. Butler and Mr. J. L. Baillie, Royal Ontario Museum of Zoology) would either asphyxiate the embryos or imprison them within the shells. Against its high efficiency this method is somewhat expensive and laborious when several thousand clutches have to be treated.

The writers undertook, with the kind assistance of Prof. G. C. Hodgson, Department of Animal Science, University of Manitoba, to originate a chemical treatment which would be cheap, effective and could be safely and easily applied by anyone. It was desired to obtain a solution which could be applied to the eggs in the nest by means of the common three-gallon pressure spray can and which would seal up the pores of the shell and cause asphyxiation or pass through the pores and kill the embryo directly.

Twenty-nine different mixtures or single substances in liquid form were tried using hen eggs of different stages of incubation and maintaining untreated eggs under identical conditions as controls. Eggs were candled before and after each experiment to determine their viability. The test substance was usually allowed to act for 24 hours before a check was made.

Fuel oil, "water glass" and various substances were tried but only the following five gave a complete and consistent kill of hen embryos:

Number	Substance	Proportions
#18	Lead acetate	1 lb.
	Alum	1 lb.
	Water	3 gals.
#21	Boiled oil	undiluted
#23	Methyl hydrate	1 gal.
	Acetic acid	½ gal.
	Glycerine	1 gal.
	Water	7½ gals.
#25	Acetic acid	½ gal.
	Formalin	1 gal.
	Cresylic acid	1/10 gal.
	Glycerine	1 gal.
	Water	7 3/10 gals.
#26	Picric acid	6/10 lb.
	Water	5 gals.
	Acetic acid	¼ gal.
	Formalin	¼ gal.

Solution #25 was applied in a field test on June 27, to the eggs in 226 cormorant nests on Rowan Island reef by means of hand operated pressure sprayers delivering a dense, fine spray. Ninety-eight percent of the nests contained eggs but no young were present. The solution was applied with little effort and time and spread evenly over the upper surfaces and sides of the eggs. However, it was found to be less efficient in the treatment of cormorant eggs than hen eggs. When this reef was visited again on July 31, 140 nests were occupied by 292 young varying from one to two weeks in age. It is remotely possible that some of these young might have originated from eggs which were laid after the treatment was applied, but this is very doubtful and the method is considered to be not more than 50% efficient at best.

Whether or not the other solutions would have been more successful in the field is unknown as an opportunity to test them has not yet been present.

### Summary

Brief investigations of the cormorant situation on Lake Winnipegosis during five different summers over a period of nine years have revealed the following information relative to the local situation:

1. Prior to 1943 the cormorant population of Lake Winnipegosis had apparently increased progressively and during the nesting season of that year reached an estimated total of 35,956 on four of the larger reefs near the north end of the lake.

2. In 1945 a complete survey revealed the lake formed the nesting habitat of an estimated 39,448 birds distributed over twelve reefs.

3. The number of nests per colony varied from 10 to 5,292.

4. There was evidence that some reefs which had been used extensively at an earlier date had been abandoned and that some others had been taken over recently.

5. The number of eggs per clutch averaged from 2.43 to 3.63 from year to year.

6. If the first eggs or the first young of the season are destroyed at an early age about 50% of the reproducing pairs will renest again almost immediately.

7. Fish consumption is large and comprises about 7.2% commercial species.

8. Consistent destruction of the eggs and young appears to reduce the breeding population fairly effectively but it was not possible to determine how many were driven to seek new nesting areas or what the mortality from natural causes was.

9. Five different chemical solutions were found to give 100% kill of hen embryos but the only one tried on cormorant eggs in the field gave not more than 50% efficiency.

10. The cormorant population on Lake Winnipegosis is now at a level where the problem in connection with fish predation is less acute than formerly but still requires attention.

11. From the aesthetic point of view adult cormorants are not objectionable, but the writers in long zoological experience have encountered few situations less attractive than a cormorant rookery.

#### Acknowledgments

The writers are greatly indebted to Mr. M. G. Kavanagh, Mr. S. Oliver and Mr. D. R. Moir who formed members of the field parties or sent in information. Thanks are also expressed to Professor D. C. Hodgson, University of Manitoba, and Mr. G. E. Butler, Supervisor of Fish Culture for much kind assistance and to the Game and Fisheries Branch, Province of Manitoba, which financed this work.

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## FURTHER NOTES ON THE PANTHER in the NORTHEAST <sup>1</sup>

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### INTRODUCTION

**M**Y FIRST PAPER on this subject (Wright, 1948) caused considerable comment in the press which resulted in a flood of reports from different areas which I had not previously visited in the course of this study. However it did not still the skepticism existing in some quarters as the concrete evidence consisted of track photographs in snow and plaster casts of tracks in earth. In the three years since the publication of that paper I have accumulated considerable additional photographic evidence, including the only picture of a New Brunswick panther ever taken, and a number of new sight records and track reports. These additional data have altered my first conception of the status of the species drastically, and I wish to present them here.

### LOCAL NAMES

The old name for the panther or mountain lion in New Brunswick and Maine is the Indian Devil. This has caused confusion with the wolverine, which was known by this name across large regions to the north and west, and for this reason the two were confused in some of the earlier accounts of New Brunswick wildlife. Cooney (1832) says "The CARCAJOU, probably the catamount . . .", and Dashwood (1871) says (p. 187) "I once heard at night on the Miramichi waters a most hideous howling, and was told by Sebattis" (his Indian guide) "it was an 'Indian Devil'." He took this to mean a wolverine. Thoreau (1858) gives the Penobscot Indian name for the Indian Devil as "lunxus", and on the east branch of the Penobscot he found a large track which his Indian guide says was that of "Devil (that is, Indian Devil or cougar) lodges about here — very bad animal . . ." He was told that the scream of a cougar had been heard about Mt. Katahdin recently, and they were not far from the mountain. In talking to another Indian he says "The last mentioned Indian spoke of the 'lunxus' or Indian Devil

(which I take to be the cougar, and not the *Gulo luscus*) as the only animal in Maine which man need fear; it would follow a man, and did not mind a fire." This confusion probably contributed to the lack of more detailed references to the panther in early records.

### THE RECENT INVASION OF WILD DOGS

An invasion of feral dogs in various stages of breeding back to the aboriginal type has taken place in New Brunswick in the past ten years. Sightings of these animals have undoubtedly been the foundation of some of the reports that were taken to refer to the panther at the beginning of this investigation. A typical case is that of the Rexton lamb killings in 1950. A report reached the Station that a panther was killing lambs near Rexton, Kent County, and the animal was caught in the act.

Investigation showed that the observer drove a team up to his sheep pasture and found the sheep running in all directions in panic. In the middle of the field chasing them was a large animal grizzled grey in colour, with prick ears and a long pointed snout. It had long thin legs and a figure "like a greyhound", and jumped a five foot fence with ease without touching the top rail. While he watched helplessly, as he was unarmed, it caught a lamb weighing about thirty pounds and picked it up in its jaws and ran off with it easily. About a dozen lambs were killed in the district, and they were all killed by a bite in the flank and very little was eaten off each carcass. The killings stopped as suddenly as they began as the animal apparently moved away. There seems little doubt from the description of the animal and the method of killing that it was a *canid*, and as two skins and a skull of feral dogs of this size and shape are in the Station's collection, and one from this district, it is almost certain that the predator was a wild dog and not a panther.

The data have been screened for any reports that might have originated in sightings of these animals.

<sup>1</sup> Received for publication May 23, 1952.

TABLE 1. PANTHER REPORTS FROM THE NORTHEAST (up to 12/31/51)

Province or State	Sight Records	Sign Reports			No. Killed	Unchecked Reports
		Tracks	Kills	Voice		
New Brunswick	105	36	15	21	5	—
Maine	12	—	2	1	1	—
Nova Scotia	6	—	—	1	—	—
Quebec	1	—	—	—	—	—
Vermont	—	1	—	—	—	Several
New Hampshire	—	—	—	—	—	Several
Massachusetts	—	—	—	—	—	1
New York	—	—	—	—	—	1
Quetico-Superior	—	—	—	—	—	Several
TOTALS	124	37	17	23	6	

THE SOURCE OF THE DATA

The data used in this paper are of two main types. The first and most important source is an actual sight record of the animal. These sightings were investigated in the field whenever possible and the eye-witness interviewed. When this was not possible a written statement was obtained from the eye-witness and the report evaluated on the basis of this statement. The same procedure was followed in the case of the second source, sign reports. Sign might be either tracks, kills, or voice. The last type is of course the most difficult to evaluate, but as the animal has been actually called into sight by replying to its calls on several occasions, there is no reasonable doubt that this source should be included. The observations of McCabe (1949) and Allen (1950) are the latest in a long series testifying to the fact that a panther screams, and as this manifestation of the animal's presence has often been reported in New Brunswick, it is recorded here with as much weight as the other types of sign.

The number of the different types of observations which are the basis of this paper are given in Table 1.

No attempt has been made to follow up the reports listed in the last column as it is felt that to do so from this distance would not greatly increase their value. They are mentioned in the hope that they will be investigated by competent biologists with open minds in these areas.

The Reverend W. J. Ballou of Chester, Vermont, formed an association of people who had seen a panther or its tracks in that state about 1935. He gathered many sight records and track reports, and a plaster cast

of a panther track was identified at the American Museum of Natural History. This information was kindly furnished by Dr. Robert T. Hatt, Director of the Cranbrook Institute of Science, Bloomfield Hills, Michigan.

Mr. Charles Larned Robinson of Intervale Farm, Intervale, New Hampshire, has conducted a search for sight records and track reports in the vicinity of his state, and has accumulated considerable information. He is one of the few investigators who have been fortunate enough to see the animal himself.

A report from Williamsburg, Mass., in 1949 stated that a cub had been seen and an adult heard calling in that vicinity, and Manville (1951) cautiously reports a sight record by several members of the Trailside Museum staff at Bear Mountain, New York, in the autumn of 1935. Moving west almost to the edge of the plains, a report of Swift (1948) says that "sight records since 1940 leave little doubt that at least a few still are present" in the Quetico-Superior country.

The Quebec record was made in the first week in June, 1947. Two observers reported the animal at a camp on Hawk Lake, 25 miles N.E. of Buckingham, P.Q.

The data from New Brunswick, Nova Scotia, and Maine will now be dealt with in some detail.

SPECIMENS TAKEN IN THE NORTHEAST

This investigation has uncovered six accounts of panthers shot or trapped in New Brunswick and Maine. They are: —

1. The late William J. Scott, pioneer lumberman of Fredericton, reported that two trappers of Caverhill Settlement, York County,

New Brunswick, trapped an 'Indian Devil' about 1880. Mr. Scott remembered the incident well as he was a friend of both the trappers.

2. The specimen trapped at Springhill, York County, N.B. in 1900 and reported as Case 1 of N.B. sightings in Wright (*ibid*).

3. The animal trapped by Gullison and Carey about 1904. Case 2 of N.B. in Wright (*ibid*).

4. The animal shot and killed by Farrell in Maine in 1915. Case 2 of Maine Reports, Wright (*ibid*).

5. The following report as it appeared on Page 1 of the Saint John Telegraph Journal for November 24, 1923.

#### "SHOOTS A PANTHER IN NEW BRUNSWICK

Animal rarely found in the Province killed in Northumberland.

Newcastle, November 22:

While superintending the work in the lumber woods on the headwaters of the Sevogle River last week Collingwood Fraser, foreman for William M. Sullivan Ltd., saw a large animal which he thought was a wildcat. Procuring a rifle Mr. Fraser fired and wounded the animal, whereupon it charged him, but a second shot fired when the beast was less than five feet away killed the animal which upon examination proved to be a panther or cougar.

Persons who saw it say it measured about four feet in length and had a tail almost as long as its body . . ."

Mr. Fraser is since deceased and investigation has not uncovered any further evidence.

6. The following is the only incident which has come to my notice in which an effort was made to photograph the animal and preserve the skin.

In March 1932 Mr. Havelock Robertson of Mundleville, Kent County, N.B., and Mr. Roy Grant of Halifax, N.S. took up the trail of a panther in fresh snow near Mundleville. They tracked the animal for only a short distance and found it sitting in a large pine tree. Two shots from Mr. Robertson's Lee-Enfield .303 rifle brought it down, and it was found to measure 7 ft. 3 in. from tip to tip. The carcass was case-skinned, and the accompanying photograph shows Mr. Robertson holding up the skin.

The skin was kept in Mr. Robertson's house until it became full of moths and

thrown away. The carcass was thrown into the river, so all that remains of the specimen is the photograph appearing in this paper. Another picture first appeared in the Halifax Chronicle under the caption "The What Is It?", where it was promptly identified as a panther or cougar by the late Bonnycastle Dale. It was through the help of Bonnycastle Dale Jr. that I was able to locate this photograph as a clipping had been preserved among his father's papers. This is the only photograph ever taken of a New Brunswick panther.

#### PANTHERS THAT HAVE BEEN WOUNDED OR TRAPPED AND ESCAPED

Panthers have been shot at on several occasions in this region, and the following are cases in which the animal was wounded and escaped.

1. An account of the wounding of a panther in Maine is given by Seton (1929) as follows:

##### "MAINE

Norcross. Charles H. Daisey, the well-known guide of Camp Phoenix on Sourdnhunk Lake, about 50 miles from Norcross, was coming to the latter place early in the fall of 1907, when he met two panthers and wounded one with his revolver, but it got away. He saw their tracks before and after the encounter and has no doubt that they were panthers."

2. The next year (1908) the following experience occurred on Porter Brook, a tributary of the Miramichi: —

The observer, accompanied by a guide, saw a panther in a tree about thirty feet from them. He shot it through the shoulders with a .30-30 Winchester rifle and it slid off the branch and hung for a moment by its hind claws before dropping into the thick underbrush below.

"McKeil and I hunted for days for that cat and never did find him — That cat had a tail a good three feet long and I should judge the body to be about twice as long as the tail. Incidentally the tail kept lashing all the time the cat was looking at me; no other movement."

3. In October 1921 a resident of Jemseg, Queens Co., N.B. went out to tend his traps. He had just reached the back of his field when he saw a large panther at a distance of 25 yards. He was carrying a shotgun loaded with bird shot and he hurriedly slipped in a



Figure 1. The 'lunxus' of the Penobscot Indians, the "Indian Devil" of the early settlers, and the *Felis concolor* of today. The only New Brunswick panther ever photographed. Shot in March 1932 at Mundleville, Kent Co., N.B.



ball cartridge. He fired and hit the panther in the foreleg and knocked it down. It sprang up and made off quickly on three legs. He examined the place where it had fallen and found blood, hair, and bone splinters. One of the splinters is in the Station's collection. It matches well the bones of the foreleg of a cougar skeleton in the National Museum of Canada.

4. Case 34 of N. B. in Wright (*ibid*).

5. On the 25th of October, 1948, a deer hunter was hunting on Coleman Brook, a tributary of Pollett River, Albert County, N. B. He saw a panther watching him at a distance of 40 yards, and after some manoueuering for position, during which the panther changed position several times, he fired. The panther leaped straight into the air and disappeared into thick cover in one bound. A bullet mark on a tree showed that he had shot low and apparently raked the animal's belly. Hair was scattered over an area of 3 x 5 feet, but no blood was found. He gave a very careful description of the animal, and stated that the hair he picked up was lighter than the colour of the animal's sides, as would be expected from the ventral regions.

# PHYSICAL DESCRIPTION OF THE ANIMAL

*Colour:* The best source of information on the physical characteristics of the northeastern panther is the photograph of Mr. Robertson's skin. This shows an animal with a definitely dark dorsal area over the hind quarters and along the top of the tail where it terminates in what is apparently a pure black tip. The backs of the ears are dark and the interiors are light coloured. The toes of the right hind foot, the only one visible, appear dark. The animal is presumably an adult as it measured 7 ft. 3 in. in the flesh. This agrees well with the accounts given by eye-witnesses of other specimens. Note the similarity to the description of *Felis dorsalis* Rafinesque from the Alleghany Mountains of Pennsylvania which was described as spotted on the sides with a black band all along the middle of the back. (Young & Goldman, 1946, p. 205).

The colour of forty-two separate specimens was described by eye-witnesses. These descriptions are listed in Table 2.

This table shows that the northeastern panther is usually a dark coloured animal on the back and sides in various shades from

dark brown almost black, through dark red and fawn, to a brindled grey. The most frequently observed colour is dark brown and it is apparently darker than the western cougar. This is to be expected in a forest animal.

Some reports of exceptionally dark specimens are as follows: —

In August 1940 a panther was observed at a range of only 35 feet. The light was poor and the observer could not be sure of the exact colour, but it was very dark all over. "This animal reminded me of a black panther but it may have been brown instead."

In March 1943 a truck full of men were driving from Fredericton to the Miramichi. They were going slowly near the top of a hill when they saw a panther on the side of the road. It was standing broadside to them and looking at them over its shoulder. They slowed down and stopped about fifty feet from it. It remained perfectly motionless except for a slow waving of the tail. They observed it for several minutes with the motor shut off. When they restarted the truck it made one fifteen-foot bound into the woods. The man in charge of the party describes it as six feet overall, about twenty inches at the shoulders, and blackish or dark brown on the head and back. This shaded to tawny on the sides and rump, and cream coloured beneath. The hair was very short and glistening, making the animal appear in excellent condition.

On July 15, 1948, the Provincial Veterinary Pathologist, and a District Veterinarian, both of Fredericton, had an excellent view of a panther under good conditions for observation about twenty miles from Fredericton. The panther crossed the road ahead of their car and stopped on the side of the road. When first seen it was mistaken for a bear because it appeared black. They drove up to within ten-fifteen yards and stopped the car. It then bounded up the cut-bank and disappeared in the bush. They described it as dark brown, almost black in colour, 2½-3 feet at the shoulders, body "as long as a full-grown bear" for which it was first mistaken, with a tail 3 feet long and the same size all the way down, and 3-4 inches in diameter. The ears were short and rounded, and the animal was very heavily set, particularly in the forequarters.

It appears that very dark individuals of the species occur in this region, and it is the first place in North America where this has

TABLE 2. — COLOUR DESCRIPTIONS OF THE NORTHEASTERN PANTHER

42 specimens

Description	No. Observations	Classification
"Tawny yellowish"	3	Medium
"Reddish brown"	2	Dark
"Deer coloured"	4	Medium
"Light rust brown"	1	Light
"Dark brown"	8	Dark
"Light brown"	2	Light
"Brownish"	5	Medium
"Dark grey"	2	Dark
"Yellowish grey and reddish"	1	Medium
"Light fawn"	2	Light
"Dark tawny back, sides yellowish, white flanks and underparts"	2	Dark
"Blackish, or dark brown head and back, cream underparts"	1	Dark
"Greyish like police dog or bobcat"	2	Medium
"Dun coloured"	1	Medium
"Dark red"	1	Dark
"Dark brown to black"	3	Dark
"Reddish grey with underparts dirty white"	1	Medium
"Black"	1	Dark
Total 42		
Light .....	5 observations	
Medium .....	17 observations	
Dark .....	20 observations	
42		

been reported as at all common. However it must be remembered that all dark coloured animals appear black when seen in dim light, especially if wet.

#### WEIGHTS AND MEASUREMENTS

The only actual measurement available is that of Mr. Robertson's specimen. However a number of other observers have had an opportunity to estimate weights and measurements in the field. Making due allowance for the doubtful value of estimates of live animals seen for a very brief time under field conditions, it is possible to arrive at an overall impression of the animal's size from these observations. The estimated weights and measurements of 42 separate specimens from the northeast are given in the following table, and they are compared with the actual weights and measurements of 24 Arizona specimens. (Arizona data from Young and Goldman, *ibid*, pp. 54).

The overall maximum length of 10 feet is within the reported limit of the species, although it considerably exceeds the actual measurements of the Arizona specimens. A puma of eleven feet two inches is reported from Patagonia, (Field and Stream, December 1947), but about nine feet is the maximum reported from North America. There are no data on body length for Arizona, but tail length agrees very closely with the estimates of the northeastern observers. The estimates of height are also in close agreement with the actual measurements, but weight appears to have been overestimated although the figure given is entirely reasonable. The difficulty of estimating live weight in the field is well known to fieldmen.

These observations do not suggest any significant differences in the gross measurements of the northeastern race from those of the west.

**TABLE 3. — COMPARISON OF ACTUAL WEIGHTS AND MEASUREMENTS OF 24 ARIZONA SPECIMENS WITH ESTIMATED WEIGHTS AND MEASUREMENTS OF 42 NORTHEASTERN SPECIMENS, ALL ADULTS**

Weight and Measurement	No. Obs.		Average		Range	
	Ariz.	NE	Ariz.	NE	Ariz.	NE
Overall length Ft.	24	19	6.2	7.0	4.2 — 7.1	6 — 10
Body length Ft.	—	22	—	4.6	—	3 — 7
Tail length Ft.	24	17	2.4	2.6	1.8 — 3.2	2 — 4
Height In.	23	13	26	27.2	21 — 31	20 — 36
Weight Lbs.	24	9	94	148	65 — 145	95 — 200 plus

The degree of accuracy attained by some of these estimates is shown in the account of one observer, who on December 22, 1948, saw a large panther when walking along the main right-of-way of the Canadian Pacific Railway near Vespra Siding, Sunbury Co., N.B. "I would estimate that he was from tip of nose to tip of tail 8 feet long; I made this estimate because he nicely covered the standard 8-foot ties . . ." The observer was an old railwayman and would naturally think of this unit of measurement.

#### LIFE HISTORY AND HABITS

**Voice:** The voice of the panther has been discussed at length by Young and Goldman (*ibid*), and more recently by McCabe (*ibid*) and by Allen (*ibid*). Both these last observers watched the animal in the act of screaming, McCabe in the mountains of the Sierra Madre, Chihuahua, Mexico, and Allen in an animal corral in Florida. McCabe describes a loud roaring like that of an African lion, and Allen a series of loud grating shrieks repeated three to seven times in succession. The latter author also reports that females in oestrus caged next to a male were noted to make various crying and "meowing" noises which ceased after mating.

Feeding calls of the species were observed by the writer in the San Francisco Zoo on March 5, 1950. An adult male and a female were caged together and they were observed for one hour prior to feeding. Their restlessness increased as the feeding hour ap-

proached, and about half an hour before the food arrived they began to give high, shrill, and a little wheezy calls. The sound can best be written as "w-a-a-h! a-o-o-w-a-a-h!" It suggested a much smaller animal, and would not be suspected of originating from a panther. It was a weak reedy sound repeated usually 2-3 times in succession, and it would certainly not suggest the species if heard in the woods when the animal was invisible. It is interesting to note that a Maine State Game Warden fired at a panther with his pistol on September 10, 1950, in Washington County, and he reports that the animal made a "whispering noise".

On March 22nd, 1952, the writer spent 4½ hours listening to the calls of a female South American puma in oestrus at the Central Park Zoo in New York City. The animal was an adult having had one pregnancy, but was very small being only about 4 ft. overall and 15 ins. at the shoulders. She was caged across the corridor from her mate, and from 10.30 a.m. to 2 p.m. she called every 5-10 mins.

The call began with loud, high-pitched "meows" very reminiscent of a large tomcat, and these built up to a loud, high, rasping continuous cry which lasted 10-15 seconds. The volume of sound was considerable and brought people running from the other end of the building to watch her. It was very different from the deep, full sound made by the lions, tigers, leopards and jaguars, and



Figure 2. The trail of a small panther that crossed the St. John River at Maugerville, Sunbury Co., N.B., on January 27, 1948. Tail-drag is present between every pug mark as the animal is crossing an open field in daylight and is keeping as low as possible. It was observed from a distance of seventy yards as it made this trail.

it suggested a much larger animal than the little puma. She gave this call when walking, standing still, and sitting down. Her lips were drawn back and her mouth was open to full gape at the peak of the cry. It was repeated 2-4 times in succession.

Loud screams have been reported in the northeast on at least 23 separate occasions. These screams can be definitely associated with a panther in at least three cases. The first incident is Case 3 of N.B. Reports in Wright (*ibid*). In this case the panther was called into view by a man answering its calls which were thought to be a man lost in the woods. It remained in sight for some time and was not frightened off by two men and a fire, and stayed around most of the night.

In December 1944 a young girl and her uncle were skating on a lake at South Musquash, St. John County, N. B. They heard

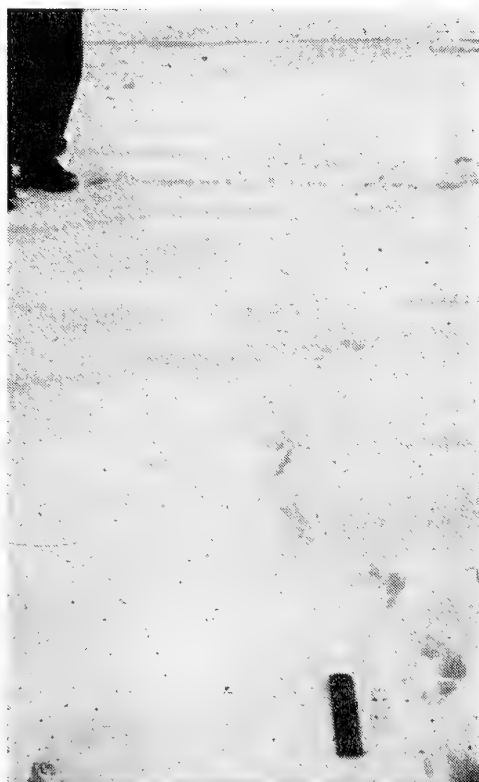


Figure 3. The trail of a large male panther. Note the tail-drag between the third and fourth pug marks from the bottom. A six-inch ruler and the man's legs give the scale of the picture. St. John Co., N.B., March 29, 1947.

cries which they thought were someone in distress in the woods beyond the lake. They stopped to listen and the cries were repeated, and then "the awfulest howl" came from seemingly much nearer than where the cries had come from. They started for home and they thought the animal was following them as the howls sounded closer. The next day the man returned and found large cat tracks three times the size of a bobcat's track along the edge of the lake. It had come right to the border of the lake and made leaps of 12-15 feet in the snow.

The third case occurred on October 29, 1948, near Millville, York County, N. B. Two men were employed in swamping out a road and they had been working all day in the woods. Just as they were about to finish for the day they heard a call in the woods which they mistook for a man hallooing. They answered and got an immediate reply. The sound came from much nearer and they

then realized that it was not a man but an animal, and that it was coming toward them. It came out on the portage road and they saw it was a panther as the long tail was clearly visible. It followed them out to the edge of the clearing and came up very close on several occasions. They arrived at the store in Millville considerably frightened and took some time to collect their wits. The storekeeper then called the Wildlife Station and I got the men's story.

An incidence of two animals following two armed men with a lantern and calling repeatedly is given in N. B. Case 6 in Wright (*ibid*).

The mating chase was seen in February, 1948. Three observers of Central Blissville, Sunbury Co., N.B., watched a large panther followed by a somewhat smaller one come out of the woods and cross their farm at the dead run without paying any attention to the buildings, at 1 p.m. The next day at about the same time another panther crossed the farm following the same route. The following night a deer was killed on the main road. The deer was eaten out leaving nothing but the leg bones attached to the hide. Note the similarity of this kill to that described in the Food Habits section.

*The Den:* The den has only been seen once. This is a report from Dr. William J. Long of Stamford, Conn. In July 1890 he was making a trip up the Little Southwest Miramichi in company with Dr. Cox of the University of New Brunswick. He was walking along the bank when he came to the mark of a carcass being dragged up a hillside. Following the drag he found the body of a yearling caribou, and he thinks that his approach frightened off the killer. He caught a glimpse of a dun coloured animal but it was not enough to give him a clear view of what it was. Following in the direction of the drag he found a den in a hollow with tracks of one large panther and at least one cub. The place stank of cat smell and carrion. The den was a shallow depression in rough rocks.

*The Cubs:* The cubs have been reported on six occasions. On two of these they were actually seen, and on the other four their presence was indicated by sign. An observer reports that about 1923 "My husband, young son and I were taking a drive on an abandoned road through a dense forested country near Coverdale, Albert County, . . . we saw a good-size tawny coloured animal with a long round tail following the road in front of us.

When it reached the clearing it left the road and sat down facing the road about ten feet from us. It watched us closely as we drove by and never moved, so we got an excellent view of it. It's head was round like a cat's and it looked like the pictures of panthers I have seen.

On the opposite side of the road was a clump of bushes where two kittens were playing quite close to the road. Like the large animal they showed no fear of us, and resembled her but were spotted, and were about the size of a large domestic cat."

Cubs have been seen or their sign reported in March, April, July, October, and November. They have ranged in size from the spotted kittens described above to the yearling that helped its mother clean out a deer in one night in November, 1947 (see Food Habits:—Deer).

#### *Numbers travelling together*

There are 157 reports from New Brunswick, Maine, and Nova Scotia, up to the end of 1951, which specify the number of animals travelling together. A single animal was reported in 92% of these reports, two together were reported in 5%, and three together in only 3%. This behavior is similar to that of the western races which spend most of their time alone after the family group breaks up.

#### *Food Habits*

The food habits data available include actual kills, reports of panthers seen stalking a prey species, and tracks of panthers hunting prey species. The following table shows the number of kills and hunting observations on hand at this writing.

One observer was the eye-witness of an almost classic example of a deer kill about 1932. He was hunting deer about 5 miles from Albright's Corner, on Little River, York Co., N.B. He was walking along a portage road and had just crossed a good-sized stream. About a hundred yards beyond the stream he heard heavy breathing coming toward him down the portage and he stepped off into the bushes. A buck deer came down the portage running hard with a large tawny cat with a long tail held straight out behind running just behind it. The buck was panting hard and it was this sound that he had first heard. The cat appeared to him to be about eight feet overall. When the deer reached the stream it leaped in and the cat followed so close behind that the two splashes sounded

**TABLE 4. — PANTHER KILLS AND  
HUNTING OBSERVATIONS  
(to 12/31/51)**

Prey Species	Kills	Hunting Observations
Deer	15	
Caribou	1	
Bobcat	1	
Otter		1
Partridge		1
Frogs		1

almost as one. He had a strange rifle with him and he did not feel much confidence in it, and the size of the cat so impressed him that he left quietly in the other direction and left it to its meal.

An example of a deer kill that was credited to a panther on the evidence of sign is as follows:

Date: November 28, 1947.

Place: Six miles down Goose Creek road from Shepody road, St. John Co., N.B., 1 mile in bush.

Observers: Kill found by Freeman McKnight and Horace Slipp of Sussex who shortly afterwards met Warden John Richardson and took him back to see it. Kill located by watching ravens circling. Carcass was then moved to Sussex where it was examined by the writer. Time: Kill found at 7.30 a.m. lying hide-side up and still warm enough to melt off snow which fell until 5.30 a.m., i.e.: KILLED THAT NIGHT.

Location: The kill was found in thick cover on the edge of a swamp. There was no sign of a struggle such as blood or hair, i.e.: KILL NOT MADE THERE, BUT CARCASS CARRIED INTO DENSE COVER TO BE EATEN. Was it a cripple? McKnight and Slipp had been hunting in the district for a week and had not seen any sign of other hunters. They had not fired themselves, i.e.: DEER NOT WOUNDED BY HUNTERS AND DIED.

Tracks: One inch of soft snow fell up to 5.30 a.m. and covered all tracks. Kill was circled for a radius of half a mile but no tracks of any sort were found.

The Carcass: The hide, legs and lumbar portion of the spine were together. The forward portion of the spine and the rib cage were some distance away. The carcass was very neatly skinned down the belly with foot-long

claw strokes. The head, neck, belly skin, and tail were missing. All meat and viscera consumed, 90-100 lbs. in this deer, and very little blood left on the snow. The round bones were carefully cleaned by rasping with the tongue, leaving no tooth marks.

One oval hole 1 in. x  $\frac{3}{4}$  in. in back of the neck  $1\frac{1}{2}$  in. from edge of hide where head and neck were torn off. ONLY INTERNAL BLEEDING ON HIDE around this hole, i.e.: HOLE MADE BY ONE CANINE TOOTH OF PREDATOR WHICH GRASPED PREY BY THE BACK OF THE NECK. One similar hole found on edge of hide near belly, and on one hind leg, BUT NO INTERNAL BLEEDING at either of these holes or at several other holes, taken to be claw holes, made while skinning the carcass after death. The holes made by the remaining three canine teeth of the predator would be on the skin of the neck, which is missing.

The spinal column was PULLED APART leaving long strings of tendons attached to each section, i.e.: MORE THAN ONE ANIMAL FED ON THE KILL AT THE SAME TIME.

Claw marks on hind legs, but none on shoulders, i.e., PREDATOR LONG ENOUGH TO GRASP DEER'S HEAD WITH FORE-PAWS WHILE HINDPAWS ON DEER'S HIND LEGS — MORE THAN FOUR FEET LONG.

Burying: No attempt was made to bury the carcass PROBABLY BECAUSE THERE WAS NOTHING TO RETURN TO, but head and neck may have been buried, and were not found.

SCAVANGING: No evidence. Ravens circling but had apparently not begun to feed when kill found.

#### DEDUCTIONS:

1. Predator carried kill to site of meal. Evidence: no signs of struggle where kill was found.

2. There was more than one animal feeding on the carcass at the same time. Evidence: vertebrae pulled apart, 90-100 lbs. of flesh and viscera consumed in one night.

3. Kill was made by animal, not man. Evidence: no men about.

4. Kill was made by clawed animal which killed by biting back of the neck when grasping the head in its forepaws, with its hind-paws on the deer's upper hind legs, i.e.: a four-foot long animal which jumped on the

deer's back. Evidence: canine tooth mark on back of neck, claw marks on hind legs, no claw marks on shoulders.

5. Predator has habits of burying part of kill. Evidence: head and neck missing.

*Predatory Animals of the Region:*

1. Wild dog.

Evidence for: none.

Evidence against: the method of killing.

2. Black bear.

Evidence for: capable of killing in this manner and consuming this quantity of food.

Evidence against: bones not crushed, meat rasped off bones with tongue, bears all fat and about to den up at this date and not prone to hunt deer.

3. Bobcat.

Evidence for: large cat might be capable of making this kill in this manner.

Evidence against: carcass carried to site of meal, hide neatly skinned out and not shredded and torn up, amount consumed too great for single or even a pair of bobcats, size of canine tooth hole in back of neck.

4. Lynx.

Evidence for: same as bobcat.

Evidence against: same as bobcat, species very rare in this region.

5. Panther.

Evidence for: carries prey to site of meal, at least three in region and two travelling as a mother and three-quarter grown cub, meat rasped off bones, habitually kills in this manner, often buries remains of kill, at least four feet long, two animals feeding together, i.e., mother and cub or mated pair, body skin all in one piece, size of canine tooth hole in back of neck.

Evidence against: none.

*Conclusion:*

Deer was killed and eaten on the night of November 28. The kill was made within a half mile of the site of the meal. Kill was probably made by the female panther who was joined by her yearling cub in eating it.

This kill is shown in the accompanying photographs.

A panther was surprised in the act of stalking a flock of partridge in the fall of 1939, and one chased a bobcat up a tree and ate it scattering bits, including the tail, about the base of the tree in March, 1941, (Case 24, N. B. in Wright, *ibid*). It is interesting to note that Connolly (1949) quotes Mr. Ed Griggs of Salt Lake City, Utah "I saw by

tracks in the deep snow where she had caught a bobcat to feed the cubs. All that was left was a front and hind foot and part of the head. Since then I have noticed where four different bobcats have been killed and eaten by a lion."

An unusual feeding habit was witnessed in the outlet of Porcupine Lake, Charlotte County, N. B. In June 1944 the observer was fishing in the outlet with two other men. They heard a noise "like the water injector on a steam engine" coming toward them along the shore behind a fringe of alders, and they could also hear some animal splashing in the water. They paddled up to the alder fringe and the man in the bow stood up. He saw "an animal as large as a man, the colour of a deer, and with a long tail, standing on its hind legs in the water. It first made me think of a kangaroo because of the long tail. We thought it was chasing frogs by standing up on its hind legs to spot them and then pouncing. That was the splashing noise we had heard. When it saw us it dropped to all fours and made off slowly without any haste, and apparently unfrightened. We had a revolver with us, and I was close enough to hit it, but it was so big that I did not feel like taking him on with a hand gun." Note the similarity of this description to that given on pp. 134 of Young and Goldman (*ibid*) when the animal was hunting mice.

There is another account of a panther standing on its hind legs which I will include here. Two observers had the following experience in the late summer or fall of 1948 at East Thorndike, Waldo Co., Me.

" . . . One morning I glanced out the window and saw what I believed to be a man with a white shirt standing in this" (raspberry) "patch. This being unusual I went outside to watch more closely. In a few minutes he seemed to vanish and then out into the open field stalked a long animal. I had seen pictures of panthers and it immediately came into my mind.

The animal was at least six feet long and around 30 inches high with a long tail. I may not remember accurately now . . . but it seemed to me he was dark grey. My daughter seeing him thought he was more on the brown colour. The morning after my neighbor reported hearing some horrible screaming (like a woman) in my woods





Figure 4. A deer kill attributed to panthers in St. John County, N.B., in November, 1947. The kill as it was found; hair side down, and still warm enough to melt off fresh falling snow. Legs and lumbar portion of the spine still attached to the hide.



Figure 5. The same kill as above. The death wound. The hole made by one canine tooth of the predator in the back of the neck. The only internal bleeding found on the hide was about this hole indicating that it was made while the animal was still alive.

around 4.30 a.m. . . . Each time I saw him I was alone and watched him stalk around at least 15 minutes. I never again saw what I thought was a man's white shirt as every time he was on all four paws. . . ."

A small panther came out of the Portobello country and tried to cross the St. John River at Maugerville, Sunbury Co., N.B., on January 27, 1948. It appeared on the farm of a local resident where he and his wife observed it through 6x German binoculars at a distance of seventy yards walking over an open field in broad daylight. I followed the trail until dark that night and took it up again next day. The panther had come to an otter track and had followed it to a hole in the ice. The otter did not slide but bounded steadily for the hole suggesting that it saw the panther coming.

The caribou kill is that given in the den report by Long.

#### PREDATION ON DOMESTIC STOCK

There are two reports of predation on domestic stock. The first is from Fredericton, N.B. On November 2, 1947, the observer went out "to my sugary to get a cow with a new calf and heard her bawling. A large animal dark red in colour about 6 feet long, with striped face and a long tail 24-30 inches, and standing about 2 feet high at the shoulders had its front feet on the calf watching my dog. I went up within 30 feet of the animal. It left very fast going low down." The calf was uninjured as the dog had apparently arrived before the panther had an opportunity to kill it.

The second case took place in Nova Scotia. In December, 1949, the observer saw a panther in a snow storm in the vicinity of Blue Mountain, Pictou County. He also found a deer kill mostly eaten with panther's tracks about it. In August, 1950, three lambs were missing and the panther's tracks were found nearby. One lamb was found dead with claw marks on the neck and shoulder, and the animal was seen about a mile away the day before. It was described as a five-foot cat, although its tail was not in sight.

#### ATTACKS ON MAN

There are three reports of a panther attacking a man in New Brunswick. The first is given in my first paper and took place in 1841. The second took place in May or June 1948 near York Mills, York Co., N.B. On that date a resident of Kingsclear was

working alone cutting pulp in the woods at some distance from the rest of his crew. He left his saw and went down to the brook for a drink. He was lying flat on his face drinking when an animal jumped on his back. It fastened its teeth in the muscles of his right shoulder, but it let go when he struck back hard with his elbow. He scrambled to his feet and got his back against a tree and it came at him again. It struck out with its paw and clawed him across the right side down to the groin. He turned away to protect his stomach and it clawed him down the back, whereupon he turned and kicked it hard three times in the flank and stomach and it made off. He made his way to the Little Camp, where he was employed, with his shirt mostly torn off and bleeding freely. He was taken to Harvey where his wounds were dressed by a nurse. They healed without infection and he has no scars today, which suggests they were not very deep.

Although he is a man who has lived in the woods all his life, he was so frightened by this encounter that he drew his pay and refused to work there again. He described the animal as brown in colour with a long tail, six feet overall, but as it was crouched down when not attacking him, he could give no estimate of its height. He picked out the picture of a mountain lion on pp. 414 of Nelson's *WILD ANIMALS OF NORTH AMERICA* as his assailant without difficulty, although he did not know its name. It was not pointed out to him, instead he was asked to go through the book and pick it out himself. This he did without hesitation.

This may be another case of mistaken identity as the man was lying flat on his face when attacked, and the animal seemed to realize what it had attacked and let go after the first bite. The subsequent clawing being the normal reaction to suddenly finding itself at close quarters with a man. He was lucky the first bite had not been across the back of his neck. The victim was interviewed and his statement was corroborated by others who were present when he was brought out of the woods. They recall that several people had reported seeing a panther about that time, and there is no doubt that he was mauled by some clawed animal. They saw the wounds and helped dress them.

The third attack occurred on November 22, 1951, near the Narrows, Queens Co., N. B. A resident of this community had the following experience: — "I was returning

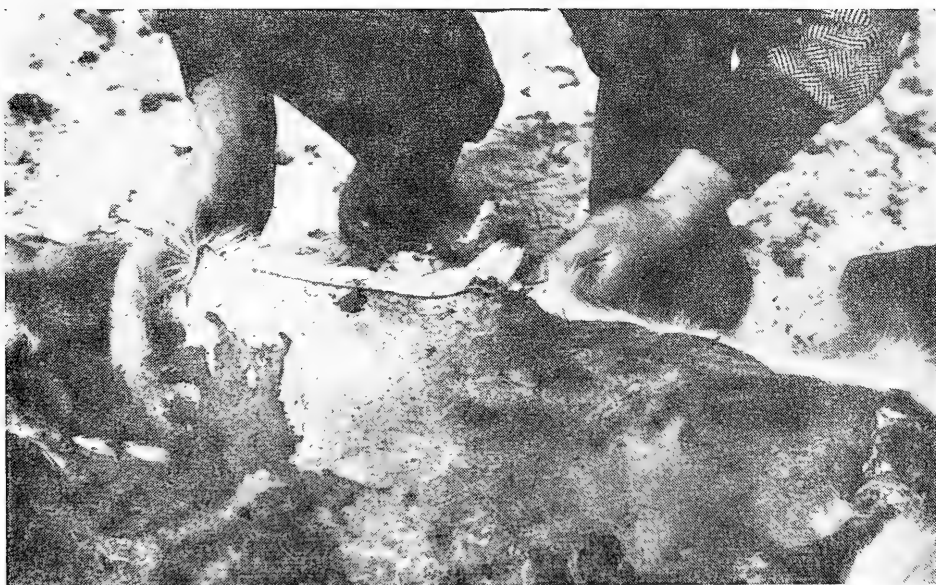


Figure 6. The carcass was neatly skinned by foot-long claw strokes down the belly.



Figure 7. The meat was rasped off the round bones with the dermal denticles of the tongue leaving no tooth marks.

home about 6 p.m. I came to a pole fence and before crossing it hit it with my axe . . . within seconds I heard five loud yells off in the woods . . . I walked about 100 yards further . . . when I heard four or five more yells. I looked back and saw it coming leaping. I ran a short way when it overtook me, so I had to stop and face it. When I stopped it stopped and stood up on its rear legs with mouth open and 'sizzling' and with front paws waving it charged. I swung the axe at it but it jumped back and I missed, so I ran for it and whooped. It leaped off in the woods and I ran for the house but didn't run very far before I saw it coming again and had to stop and swing the axe at it. It jumped up to one side so I ran for it and it ran off in the woods again . . . It repeated the same thing over and over five or six times until I came to a field where I could see the lights of the houses, then it leaped off and never came back.

The animal was black or dark grey in colour. The tail was at least  $2\frac{1}{2}$  feet long, and the animal was at least 6 feet long."

The circumstances of this attack are so unusual that the possibility of rabies must be considered. The animal was obviously not stalking the man as possible food as the loud cries emitted before it even came into sight show. The instant belligerence shown when the man made a sudden noise suggests a highly nervous state which is a symptom of this disease. It is fortunate that the victim was a grown man with an axe and not a child or a tragedy might have resulted.

Collingwood Fraser's panther charged when wounded and was killed by a second shot at very short range, and several reports mention a decided lack of fear of man on the part of certain individuals. Gesner (1847) called it "a small but dangerous animal", and Thoreau (*ibid*) was told it "was the only animal in Maine a man need fear". It appears that truculent specimens are not unknown, so that the animal should be approached with caution. The great majority however are timid in the extreme, and they constitute considerably less of a menace in the woods than the much more abundant black bear, which is nowhere considered especially dangerous.

The ease with which some specimens are killed is well shown by the account in *Outdoor Life* for November 1950 of a British Columbia guide who tied his pocket knife to a pole and climbed a tree and speared to

death an adult cougar. They can be captured alive at the rate of more than 20 a month in the western mountains by the use of dogs and a stout necker, as has been demonstrated by Clarence White of Utah.

### SWIMMING ABILITY

There are four reports of the species either swimming, or jumping into the water without hesitation, or wading. Case 3 of the Maine reports in the previous paper gives an account of a panther swimming a stream, and Case 11 of N.B. tells of the animal watched swimming a good-sized river. On August 6, 1950, two men were paddling up the Lower Digedeguash River in Charlotte County, N. B. They saw an animal swimming across the river about 50 yards ahead of them. When it saw them it turned back to the shore. The water was smooth and the animal was completely submerged except for the head and the tip of the tail. The head was round with short ears, and golden brown in colour. The tail was nearly as long as the body and had a white tip. It appeared the size of a large beagle dog as it went up the bank. It did not appear frightened and they noted it was the same brown colour all over. It was obviously a cat, and they drew a sketch with a sample colour which they submitted with their report. This was probably a cub just out of the spots, and seeing its first men.

Reports of a panther chasing a deer into the water, and wading in the shallows for frogs have already been given, so they apparently enter the water readily when the necessity arises. As the coat is not water-resistant they probably do not do so readily in cold weather.

### THE STATUS OF THE SPECIES IN THE NORTHEAST

The number of reports now available indicates that the species is by no means as rare as was thought at the beginning of this study. It appears well distributed over New Brunswick except in the north and northwest. Here the language factor enters the picture. The inhabitants of this region are mostly French and the difficulty of translation has greatly retarded the gathering of adequate information there. The number of panthers in New Brunswick is apparently far greater than the number of lynx, as less than half a dozen of the latter have been reported in the last fifteen years.

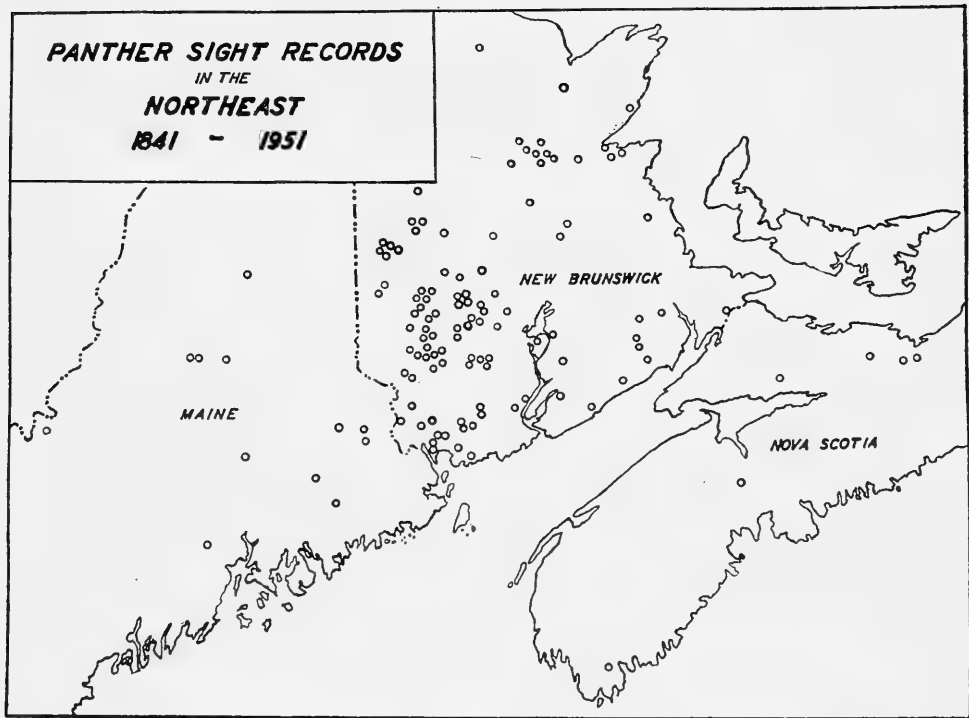


Figure 8. Map showing panther sight records in the northeast, 1841-1951.

We are apparently passing through a low of the lynx cycle, although bobcats are not affected.

The species appears to have definitely expanded its range into Nova Scotia, and the steadily rising deer population there is no doubt the cause. The New Brunswick deer population is also increasing steadily which would account for the increase in panthers indicated in the last two decades. The writer is the only one in this region who has systematically collected panther reports in the last fifteen years, and naturally most of his data come from New Brunswick. It is therefore not possible to say that there are more panthers in New Brunswick than in Maine as the same amount of effort in collecting evidence has not been made there, but there seems little doubt that the Nova Scotia records indicate a recent invasion.

The overall conclusion is that the species is on the increase and is not in danger of extirpation. The reports from Vermont, New Hampshire, Massachusetts, and New York suggest that the species is showing signs of recovery from a low that was long

thought to be absolute extinction over most of its original range. Whether this recovery originated from a surviving remnant, is due to influx, or is the result of an artificial introduction, will vary from region to region. The continuity of the records in New Brunswick strongly indicate that a remnant has survived the extirpation of the caribou and the decimation of the moose to be succored by the irruption of deer. The eastern Maine reports probably indicate an overflow from the center of abundance in southwestern New Brunswick (see map), as is undoubtedly true in the case of Nova Scotia. The western Maine and New England reports suggest an influx from nuclei of breeding stock surviving in the Appalachian Chain. However there is another possible source which must be considered. It is the possibility that small travelling animal shows may have turned loose specimens in this region when they have become bankrupt and could no longer afford to feed them. It seems probable that some of the recent reports in the east can be attributed to animals of this type.

## SUMMARY AND CONCLUSIONS

The early panther reports from New Brunswick have been screened and any that might have originated in the sighting of a wild dog have been eliminated. Over one hundred reports remained from New Brunswick, Maine, and Nova Scotia, and these are analyzed for physical characteristics and life history data. The accounts of the killing of six panthers in New Brunswick and Maine are given, and a number of cases where panthers have been wounded and escaped are discussed.

The northeastern race is found to be similar in gross dimensions to the western races, but generally darker in colour, particularly on the back and head. Accounts of calling up a panther are given, as is a report of the finding of a den. The young are described from eye-witness testimony. Food habits include deer, caribou, bobcat, otter, partridge, and frogs. The habit of standing on the hindlegs is discussed.

Two incidences of predation on domestic stock, and accounts of two recent attacks on man are given. Swimming ability is discussed and the status of the species in the northeast is reviewed.

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# STATEMENT OF FINANCIAL STANDING

## THE OTTAWA FIELD-NATURALISTS' CLUB, NOVEMBER 27/52

### CURRENT ACCOUNT

Assets		Liabilities	
Balance in Bank, Nov. 27/52 .....	\$2,827.34	Audubon Screen Tours	
Bills receivable .....	138.29	guarantee .....	850.00
Lodge, est. value .....	320.00	Balance .....	2,435.63
	<hr/>		<hr/>
	\$3,285.63		\$3,285.63

Receipts		Expenditures	
Balance in Bank, Nov. 26/51 .....	\$2,510.29	Can. Field-Nat. (5 nos.) .....	\$1,711.20
Fees:		Editor's Hon. ....	100.00
Current .....	\$1,621.88	Business Mgr's Hon. ....	15.00
Advance & Arrears .....	221.23	Binding Set of Can. Field-Nat. ....	125.40
Assoc. ....	39.00	Excursions & Lect. Comm. ....	100.00
	<hr/>	Newsletter (3 nos.) .....	69.30
	1,882.11	Separates .....	287.45
Separates & Illustrations .....	291.64	Illustrations .....	390.66
Back Numbers .....	593.04	Postage & Stationery .....	193.26
Miscellaneous .....	43.08	Bank Discount .....	26.10
Sale of Library .....	150.45	Miscellaneous .....	86.69
Audubon Tours (net) .....	461.79	Balance in Bank, Nov. 27/52 .....	2,827.34
	<hr/>		<hr/>
	\$5,932.40		\$5,932.40

### RESERVE FUND

Assets		Liabilities	
Hydro-Electric Power Comm.			
Ont. Bonds, 3% .....	\$3,000.00		
Bal. in Bank, Nov. 27/52 .....	293.16		NIL
	<hr/>		
	\$3,293.16		

Receipts		Expenditures	
Bal. in Bank, November 26/51 .....	\$ 205.32	Rent Deposit Box .....	5.00
Bank Interest .....	2.84	Balance in Bank, Nov. 27/52 .....	293.16
Bond Interest .....	90.00		
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	\$ 298.16		\$ 298.16

### PUBLICATION FUND

Assets		Liabilities	
Hydro-Electric Power Comm.			
Ont. Bonds, 3% .....	\$1,500.00		NIL
Bal. in Bank, Nov. 27/52 .....	197.40		
	<hr/>		
	\$1,697.40		



**Receipts**

Bal. in Bank, Nov. 26/51 .....	\$ 150.30
Bank Interest .....	2.10
Bond Interest .....	45.00
	<hr/>
	\$ 197.40

**Expenditures**

Balance in Bank, Nov. 27/52 .....	\$ 197.40
	<hr/>
	\$ 197.40

Audited and found correct.

(Signed) **I. L. Conners**  
**C. Frankton**  
 AUDITORS.

**R. J. Moore,**  
 TREASURER.

November 27, 1952

## ANNUAL MEETING OF THE OTTAWA FIELD-NATURALISTS' CLUB, DECEMBER 2, 1952

**Report of Council**

Since the last Annual Meeting, there were five meetings of Council held at St. Patrick's College: December 17, 1951, with 20 members present; February 2, 1952, with 19 members present; March 13, 1952, with 15 members present; October 16, 1952, with 13 members present; and November 20, 1952, with 17 members present. A meeting was also held on April 26, 1952, at the home of Dr. and Mrs. J. W. Groves, with 23 members present.

Appointments were made for 1952 as follows:

Editor of the Canadian Field-Naturalist — Dr. H. A. Senn.

Business Manager — Mr. W. J. Cody.

Chairman of the Publications Committee — Mr. A. E. Porsild.

Chairman of the Excursions and Lectures Committee — Dr. J. Arnold.

Chairman of the Reserve Fund Committee — Mr. Hoyes Lloyd.

Chairman of the Special Lectures Committee — Mr. R. Frith.

Chairman of the Membership Committee — Dr. V. E. F. Solman.

Chairman of the Bird Census Committee — Mr. J. S. Tener.

Chairman of the Library Committee — Mr. A. E. Porsild.

Chairman of the Macoun Field Club Committee — Mr. W. K. W. Baldwin.

Chairman of the Gatineau Park Advisory Committee — Mr. R. Frith.

Chairman of the Brewery Creek Bird Sanctuary Committee — Mr. R. D. Harris.

Representatives, Canadian Section, International Committee for Bird Preservation — Dr. H. F. Lewis, Mr. Hoyes Lloyd.

**Report of the Publications Committee**

Since the last annual meeting, 4 members of the Canadian Field-Naturalist (vol. 65 and 66) were published, with a total of 127 pages, the last number being May-June, 1952 issue. Papers, notes and reviews were distributed as follows:

	Papers	Notes	Reviews
Botany	3		
Ornithology	4	6	2
Invertebrate Zoology		1	
Misc.			1

Two maps and 15 illustrations were used. The business manager reported sales of back numbers totalling \$592.04. The sum of \$117.00 was spent on the binding of an official set of the Field-Naturalist.

**Report of the Excursions and Lectures Committee**

Four meetings of the Committee were held during the year at the home of Mr. and Mrs. A. E. Bourguignon at which arrangements were made for the annual dinner and the spring and fall excursions.

The usual monthly meetings of the Bird Group were held with an average attendance of about 30 members. The programmes included informal talks by members, discussions and films. Excursions were held in the spring to view the woodcock at Marchurst and the Group spent one day at the Lodge and Constance Lake area. Mrs.

Bauche was named chairman and Miss. M. Bower secretary for the 1952-53 season. A breeding-bird census was carried out on a woodland plot on the Mackenzie King Estate.

Four early morning bird walks were held under the leadership of Miss Mary Stuart, Professor J. E. Smith and Messrs. Bourguignon and Frith.

Two indoor meetings were held as follows:

April 17 — About 120 persons attended the annual dinner at the Central Experimental Farm at which Mr. Herbert Marshall spoke and showed movies of his trip to Australia and India. Displays were provided by the Macoun Field Club and the Tree and Fern Groups.

October 30 — A meeting was held at the headquarters of the Ottawa Humane Society at which Mr. Spencer of the National Film Board spoke about the birds he had seen in Korea and showed two films.

Five Saturday afternoon excursions were held at the Central Experimental Farm, the Lodge, Val Tetreau and the Mackenzie King Estate, Kingsmere. Leadership for these well attended events was provided by the study groups.

The Fern Group held monthly meetings at the home of Miss A. W. Anderson and two meetings were held at the Central Experimental Farm and one at the home of Mr. and Mrs. J. W. Groves. Four excursions were made during the year to various areas in the Ottawa district. Twenty-seven species have been collected to date in the Ottawa area.

The Tree Group met twice a month during the winter at the Museum. Its members are studying the shrubs of the Ottawa district with an aim to devise a key to the numerous species.

The Field-Naturalists' Lodge was used for two official outings, namely, the annual May 24th excursion and the fall weiner roast, but numerous unofficial gatherings took place there.

Four copies of the Newsletter were issued during the year under the editorship of Mrs. Groves. The Newsletter continues to serve well its purpose of informing members of the various activities of the Club and stimulating further work.

#### **Report of the Special Lectures Committee**

Three Audubon Screen Tours completed the 1951-52 series:

January 7 — Wild Life Down East, by Carl W. Buchheister.

February 26 — The Four Corners, by Fran Wm. Hall.

March 27 — Animals Unaware, by Howard Cleaves.

The following Audubon Screen Tours of the current series complete the programme for 1952:

October 3 — Bonaventure Diary, by Robert C. Hermes.

November 28 — Below the Big Bend, by Allan D. Cruickshank.

#### **Report of the Membership Committee**

A campaign was undertaken involving the distribution of application forms and information leaflets to Audubon Screen Tour audiences. The committee also made plans to circularize libraries and universities that might be interested in purchasing copies or sets of the Canadian Field-Naturalist.

#### **Report of the Gatineau Park Committee**

This committee met on March 22 with Mr. R. P. Sparks, chairman, Gatineau Park Advisory Committee and Mr. E. S. Richards, Park Superintendent. Mr. Richards reported that recommended plantings of shrubs and trees, which supply bird-food, had been completed. The committee recommended further planting of shrubs and trees, which has, to date, been partly completed. It is the intention to continue these plantings for several years.

The Federal District Commission carpenter shop constructed 30 bird houses as specified by the Wildlife Service. These were erected in the disturbed area of the Park during the first week of May. Mr. Harris and Mr. Tener were on hand to designate the locations of these houses.

The use of a small building on the Mackenzie King Estate has been granted the Ottawa Field-Naturalists' Club.

The committee has not yet selected a proposed undisturbed area of approximately 500 acres to be set aside for the study of Natural History.

Dr. Arnold and associates conducted during the spring and summer of 1952 on a part of the Mackenzie King Estate a bird breeding census.

Several members of this committee and the Club, who have specialized knowledge concerning park management, have been as-

sisting to equip a Park Museum, the establishment of Nature Trails and with various wild life management problems.

#### **Report of the Macoun Field Club Committee**

During 1952 the Macoun Field Club has continued the three age groups set up in the previous year. The High School Group numbers 33 and was headed by Eric Mills and a committee of four. Similar committees acted for the Middle Group of 30 under the chairmanship of Dick McGregor and for the Junior and Middle Group of 32 under Harold Savile.

The year was divided into three seasonal programmes, Winter, Spring and Autumn. A total of 25 excursions and indoor meetings was held for each group. The High School Group met regularly on Tuesdays after school. The Middle and Junior Groups met on Saturday morning at different hours so that each could attend one of the two Saturday Morning performances in the Children's Series of the National Museum Lecture Programme.

There were five special features during the year. On February 23 a party of sixty from all three groups made a winter excursion to Kilreen Farm on the invitation of Mrs. Frank Ryan. The members inspected the farm livestock and buildings, explored the fields and woodlots and had a picnic around a roaring fire. A small group related their experiences over radio station CFRA. On March 29 the Club gave the two performances of the Museum Saturday Morning show under the title "Let's All Go Exploring". At the Ottawa Field-Naturalists' Club dinner on April 17, representatives of the group committees attended and an exhibit of the Club's work was shown. This exhibit

was again displayed at the Fourth Birthday Meeting on April 26. At this meeting, Dr. Alcock, Dr. Groves and Mr. Bourguignon presented Club badges to 36 new members given by kind friends of the Club. An anonymous friend also provided a chartered bus for an Autumn excursion to Beattie Point on October 25 attended by 51 members.

The progress of the Macoun Field Club has been duly reported in each issue of the Newsletter. Two of the radio stations have made broadcasts on the Club's work. The Citizens Committee on Children displayed exhibits from the Club at the Chateau Laurier. A second and a third number of "The Little Bear" was issued and Mr. Madrox is now assembling a fourth.

As in former years, the Club provided a team of ushers for the Audubon Screen Tours and, in addition, assisted in the setting up of the stage and other duties. The Club also shipped a collection of specimens from its "museum" to a school group in Vogan, Manitoba. A most encouraging development of the Club's work has been the leadership provided by three members of the High School Group in natural history activities at summer camps. Letters from corresponding members whose families have moved to other parts of Canada show that the interest in Natural History fostered by the Club is being continued and spread elsewhere.

#### **Report of the Bird Census Committee**

The Christmas Bird Census was taken on December 31, 1951. A total of 28 species and 3,096 individuals was reported. The Christmas Bird census for all of Canada was published in the March-April, 1952, issue of *The Canadian Field-Naturalist*.

J. W. Groves, President.

H. J. Scoggan, Secretary.

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### **CHRISTMAS BIRD CENSUS — 1952**

**St. John's, Nfld.** — (City and half mile of coast at Cape Spear). December 26, 1952; 9.30 to 4.00 p.m.; temp. 37°F; overcast and foggy; no snow; 7 observers in 2 parties; 2 station observers; total hours 15; total miles 50 (10 on foot, 40 by car). — Old-squaw, 10; Glaucous Gull, 15; Iceland Gull, 24; Great Black-backed Gull, 9; Herring Gull, 21; Kittiwake, 2; Black Guillemot, 4; Rock Dove,

75 (plus); Yellow-shafted Flicker, 3; Horned Lark, 1; Crow, 168 (plus); Black-capped Chickadee, 23; Brown-capped Chickadee, 15 (plus); Golden-crowned Kinglet, 100 (plus); Northern Shrike, 1; Common Starling, 1; Palm Warbler, 2; Yellow-breasted Chat, 1; English Sparrow, 165 (plus); Purple Finch, 37; Pine Grosbeak, 15; Common Redpoll, 25; Pine Siskin, 35; White-winged Crossbill, 12;

Slate-coloured Junco, 29; Snow Bunting, 2. Total 26 species; 795 individuals (plus). (Seen in area during census week, Baltimore Oriole, 1; Starlings, 400 (plus). — Mr. & Mrs. A. G. Gosling, Miss C. Furlong, H. H. Winter, John Macgillivray, David Sergeant, Dr. Ian Bond, H. Squires, L. M. Tuck (Newfoundland Natural History Society).

**Wolfville, N.S.** — Dec. 27; 8.00 a.m. to 5.00 p.m.; total miles 55 (48 by car, 9 on foot). Canada Goose, 151; Am. Merganser, 2; Bald Eagle, 1; Rough-legged Hawk, 2; Ring-necked Pheasant, 21; Great Black-backed Gull, 15; Herring Gull, 52; Flicker, 1; Hairy Woodpecker, 1; Downy Woodpecker, 2; Horned Lark, 5; Blue Jay, 19; Crow, 144; Black-capped Chickadee, 8; Brown-capped Chickadee, 6; Brown Creeper, 1; Robin, 1; Golden-crowned Kinglet, 15; Starling, 132; English Sparrow, 733; Common Redpoll, 51; Goldfinch, 17; White-winged Crossbill, 20; Savannah Sparrow, 1; Vesper Sparrow, 1; Junco, 82; Song Sparrow, 2; Total 28 species, 1,494 individuals. — J. S. Erskine, R. Erskine, M. Gibson, W. B. Schofield.

**West Middle Sable, N.S.** — (Matthews Lake and Hemeon Head to Sable River, 9-mile Road, and 1 mi. north, 11.5 mi. between extremes). Dec. 26; 7.30 a.m. to 1.37 p.m. and 2.07 p.m. to 5.00 p.m. (owl, 8.00 p.m.); 90% cloudy; one brief, light shower; temp. 36° to 44°; wind W to NW, 5-10 m.p.h.; no frost, ice or snow. One observer at feeding station, one travelling 28 mi. (17 by bicycle, 10 on foot, 1 by car). Common Loon, 2; Horned Grebe, 4; European Cormorant, 42; Canada Goose, 350; Black Duck, 408; Greater Scaup Duck, 27; Buffle-head, 15; Old-squaw, 4; Harlequin Duck, 5; Common Eider, 6; Ruffed Grouse, 1; Purple Sandpiper, 1; Great Black-backed Gull, 61; Herring Gull, 154; Great Horned Owl, 1; Hairy Woodpecker, 3; Downy Woodpecker, 1; Horned Lark, 12; Canada Jay, 4; Blue Jay, 1; Raven, 4; Crow, 17; Golden-crowned Kinglet, 5; Starling, 28; House Sparrow, 40; Pine Siskin, 2; White-winged Crossbill, 71; Slate-coloured Junco, 28; Tree Sparrow, 2; White-throated Sparrow, 2; Snow Bunting, 16. Total, 31 species, 1,317 individuals. (Other species recorded in West Middle Sable and vicinity in December, 1952: American Golden-eye, Red-breasted Merganser, Marsh Hawk, Iceland Gull, Black Guillemot, Black-capped Chickadee, Acadian Chickadee, Brown Creeper, Robin, Myrtle Warbler, Pine Warbler, Yellow Palm War-

bler, Evening Grosbeak, Pine Grosbeak, Redpoll, Goldfinch, Chipping Sparrow, Song Sparrow). — Laura N. Lewis and Harrison F. Lewis.

**Fredericton, N.B.** — (7 miles radius centering in Fredericton; town suburbs 10%, pasture 20%, coniferous forest 70%.) — Dec. 14; 9 a.m. to 5 p.m.; clear; temp. 12° to 26°; wind NW, very light; ground covered with 4-6 inches of old snow; all water frozen except the rapids in the Saint John River above Fredericton and in a few places in the little streams in the deep woods; twelve observers in 4 parties; total party-hours, 32 (8 by car, 24 by foot); total party-miles, 150 (40 on foot, 90 by car). Am. Golden-eye, 7; Marsh Hawk, 1; Ruffed Grouse, 11; Herring Gull, 15; Rock Dove, 49; Pileated Woodpecker, 1; Downy Woodpecker, 1; Blue Jay, 1; Raven, 20; Crow, 3; Black-capped Chickadee, 11; Brown-headed Chickadee, 2; Red-breasted Nuthatch, 6; Golden-crowned Kinglet, 4; Common Starling, 7; English Sparrow, 42; Bronzed Grackle, 1; Evening Grosbeak, 3; Purple Finch, 16; Common Redpoll, 37; Pine Siskin, 85; White-winged Crossbill, 42; Tree Sparrow, 10; Song Sparrow, 1. Total, 24 species; 376 individuals. — L. Baillie, N. Balch, D. Bradshaw, J. Brown, R. Brown, A. Gordon, A. Lucas, J. McLeod, M. Moore, G. Mott, B. Robinson, W. Spriggs (University of New Brunswick Biology Club).

**Quebec, Que.** — (Quebec city, Plains of Abraham to Sillery, Bois Gomin Road; Ste. Foy and Quebec bridge area, La Canardière road to St. Grégoire, Quebec Zoological Garden and Charlesbourg; town suburbs 21%, fields 18%, coniferous forest 16%, deciduous woods 11%, mixed woodlands 21%, shores 13%) — Dec. 22; 7 a.m. to 4.30 p.m.; overcast; temp. 15° to 21°; wind NE, 8-10 m.p.h. 4-6 inches of snow on ground; small rivers partly frozen, some moving ice on the St. Lawrence River, thin ice; seven observers in 6 parties; total party-hours, 33 (30 on foot, 3 by car), total party-miles, 89 (34 on foot, 55 by car). — Lesser Scaup, 1 (at 100 feet with binoculars, R.L.); Am. Golden-eye, 19; Ruffed Grouse, 9; Ring-necked Pheasant, 1; Iceland Gull, 10; Great Black-backed Gull, 2; Herring Gull, 242; Hairy Woodpecker, 6; Downy Woodpecker, 1; Blue Jay, 1; Crow, 4; Black-capped Chickadee, 37; White-breasted Nuthatch, 1; Red-breasted Nuthatch, 10; Golden-crowned Kinglet, 1; Cedar Waxwing, 42; Common Starling, 118; English Sparrow,

925; Evening Grosbeak, 22; Pine Grosbeak, 2; Common Redpoll, 73; Tree Sparrow, 1. Total 22 species; 1,528 individuals. (Seen in area Dec. 15. Northern Shrike, 1) — R. Cayouette (compiler), C. Délisle, F. Hamel, J.-P. Laplante, L. Lemieux, R. Lepage, Ls.-A. Lord. (La Société Zoologique de Québec.)

**Montreal, Que.** — (Mount Royal, Angrigon Park, Dorval, Montreal West, Cote St. Luc, St. Helen's Island, Nuns' Island, Caughnawaga, south shore St. Lawrence River from Mercier Bridge to Jacques Cartier Bridge, and north shore from Dorval to Victoria Bridge, Saraguay, Ahuntsic, Laval-des-Rapides). — Dec. 21; overcast; temperature 16° to 19°F.; wind east 15 m.p.h.; 4 inches snow in open country; little ice on river; 37 observers in 10 parties; total party-hours, 49, total party-miles, 117 (48 on foot, 66 by car, 3 by boat). Canada Goose, 26; Mallard, 24; Black Duck, 784; Pintail, 165; Greater Scaup, 56; Am. Golden-eye, 547; White-winged Scoter, 1; Hooded Merganser, 2; Am. Merganser, 38; Goshawk, 1; Rough-legged Hawk, 4; Pigeon Hawk, 1; Sparrow Hawk, 2; Ruffed Grouse, 2; Ringed-necked Pheasant, 75; Great Black-backed Gull, 41; Herring Gull, 1,053; Ring-billed Gull, 4; Rock Dove, 234; Horned Owl, 2; Short-eared Owl, 2; Flicker, 6; Hairy Woodpecker, 4; Downy Woodpecker, 36; Blue Jay, 1; Crow, 122; Black-capped Chickadee, 110; White-breasted Nuthatch, 12; Brown Creeper, 18; Winter Wren, 1; Robin, 4; Hermit Thrush, 1; Ruby-crowned Kinglet, 1; Northern Shrike, 2; Starling, 228; English Sparrow, 273; Purple Finch, 1; Common Redpoll, 71; American Goldfinch, 19; Tree Sparrow, 41; Song Sparrow, 20. Total, 41 species, 4,035 individuals. (Seen in area December 27, Red-winged Blackbird, 1.) — B. C. Borden, Miss S. Boyer, W. J. Brown, J. D. Cleghorn, J. Delafield, P. du Boulay, Mrs. P. du Boulay, D. G. Elliot, Mrs. D. G. Elliot, D. Garneau, J. Goring, Miss G. Hibbard, A. Hipkins, Mrs. A. Hipkins, J. Howes, Mrs. M. Innes-Ket, A. Lepingwell, Mrs. A. Lofft, H. Longley, W. McBride, I. McLaren, G. H. Montgomery, Mrs. G. H. Montgomery, J. Normandin, C. J. Peake, W. H. Rawlings, Miss H. Ritchie, Mrs. P. Roberts, J. Robinson, D. Ryan, H. F. Seymour, G. Shearer, Dr. J. Summerby, L. M. Terrill, Mrs. L. M. Terrill, Miss W. E. Wilson, R. Yates (Prov. Que. Soc. for the Protection of Birds).

**Ottawa, Ont.** — (Roughly a radius of 15 miles) — December 21, 1952; 9.00 a.m. to

4.00 p.m.; clear, wind south-west 10, temperature 28°, 2-3 inches of snow; 43 observers in 17 parties; total party-hours 85, total party-miles 499 (427 by car and 72 on foot). — Great Blue Heron, 1; Mallard, 1; Black Duck, 10; Ring-necked Duck, 2; Scaup, 1; Am. Golden-eye, 262; Am. Merganser, 79; Red-breasted Merganser, 1; Sparrow Hawk, 4; Ruffed Grouse, 20; Hungarian Partridge, 25; Ring-necked Pheasant, 11; Herring Gull, 108; Brunnich's Murre, 1; Rock Dove, 771; Mourning Dove, 2; Pileated Woodpecker, 5; Hairy Woodpecker, 6; Downy Woodpecker, 15; Blue Jay, 24; Crow, 19; Black-capped Chickadee, 191; White-breasted Nuthatch, 32; Red-breasted Nuthatch, 2; Brown Creeper, 7; Golden-crowned Kinglet, 5; Northern Shrike, 5; Starling, 1,102, English Sparrow, 2,380; Red-winged Blackbird, 3; Bronzed Grackle, 1; Redpoll, 487; Hoary Redpoll, 15; Pine Siskin, 15; White-winged Crossbill, 4; Junco, 6; Tree Sparrow, 17; Song Sparrow, 4; Snow Bunting, 130. Total 39 species, 5,774 individuals. (Seen in area December 15: Carolina Wren, 1; Hairy Woodpecker, 1; December 25: Robin, 4.) — H. Brown, T. Erskin, H. Lloyd, R. Frith, Dr. & Mrs. D. Savile, T. Morland, Mr. & Mrs. H. Marshall, Mrs. Brown, Dr. Guio, C. Frankton, L. MacKinnon, A. Cowan, A. Bourguignon, Misses V. Ross, M. Flynn, D. Haight, M. Stuart, Mr. & Mrs. Bauche, Misses Stoner, Summers, Dr. & Mrs. J. W. Groves, E. Godfrey, M. Campbell, Misses V. Humphreys, A. Banning, J. Smith, E. Mills, B. Millman, P. Millman, Miss F. Cook, Mr. & Mrs. C. Bennett, K. Bowles, H. Brown, Mr. & Mrs. W. Baldwin, H. Bedard, Miss R. Horner, J. Arnold.

**Pakenham, Lanark Co., Ont.** — December 22, 1952; 7.45 a.m. to 3.30 p.m.; heavily overcast during entire day; ground bare; Mississippi River open; wind light, east; temp. 22° at 7.45 a.m., 26° at 3.30 p.m.; 7 miles on foot. Black Duck, 2; American Merganser, 2; Ruffed Grouse, 1; Hairy Woodpecker, 2; Downy Woodpecker, 1; Black-capped Chickadee, 8; White-breasted Nuthatch, 6; Red-breasted Nuthatch, 2; Brown Creeper, 1; Starling, 12; English Sparrow, 99; Evening Grosbeak, 62; Common Redpoll, 41; Pine Siskin, 40. Total 14 species, 279 individuals. December 24: Blue Jay, 3; Snow Bunting, 98.) — Edna G. Ross.

**Carleton Place, Ont.** (Roughly a radius 6-10 miles). — Clear and cold wind north west

20 m.p.h., temperature 10° to 0°, depth of snow 2-3 inches; total party-hours 15; total party-miles 98 (91 by car, 7 on foot). Ruffed Grouse, 4; Rock Dove, 45; Hairy Woodpecker, 1; Downy Woodpecker, 4; Blue Jay, 6; Black-capped Chickadee, 41; White-breasted Nuthatch, 2; English Sparrow, 244; Evening Grosbeak, 20; Common Redpoll, 189; Goldfinch, 15; Pine Siskin, 3; Snow Bunting, 220. Total 14 species, 903 individuals. — H. M. Brown, F. Bourguignon, G. E. Findlay, D. D. Findlay, E. H. Ritchie, J. H. Dack, D. K. Findlay, Mrs. D. K. Findlay, Mrs. John Findlay, Miss Julie Findlay, Mrs. Thos. Walton, W. F. Findlay, Bill Findlay, Pete Findlay.

**Kingston, Ont.** — (7½-mile radius centering on MacDonald Park, Kingston, and including Cataraqui River and Creek, shores and waters of Lake Ontario and St. Lawrence River, Wolfe and adjacent islands; farmland, 30%, urban centres 4%, marshes 12%, water 30%, mixed woodlands 24%). — Dec. 21; 8.00 a.m. to 5.00 p.m.; overcast, with intermittent snow and rain in p.m. temp. 32°; wind N.E. to S.E. 15; ground covered with 5 inches snow, deeper in drifts; marshes, rivers frozen, bays in L. Ontario largely open; St. Lawrence river open; twelve observers in 4 parties; total party-hours, 88; total party-miles 316 (49 on foot, 263 by car, 4 by boat). Common Loon, 3; Horned Grebe, 5; Mallard Duck, 2; Black Duck, 139; Ring-necked Duck, 3; Greater Scaup Duck, 1; Common Goldeneye, 827; Buffle-head, 1; White-winged Scoter, 3; Hooded Merganser, 7; Am. Merganser, 396; Common Rough-legged Hawk, 21; Bald Eagle, 3; Marsh Hawk, 1; Sparrow Hawk, 1; Ruffed Grouse, 7; Hungarian Partridge, 13; Am. Coot, 4; Killdeer Plover, 1; Glaucous Gull, 1; Great Black-backed Gull, 63; Herring Gull, 592; Ring-billed Gull, 34; Rock Dove, 47; Horned Owl, 3; Hairy Woodpecker, 1; Downy Woodpecker, 3; Blue Jay, 5; Crow, 2; Black-capped Chickadee, 63; White-breasted Nuthatch, 10; Hermit Thrush, 1; Common Starling, 523; English Sparrow, 317; Red-winged Blackbird, 1; Cowbird, 20; Common Purple Finch, 3; Common Redpoll, 550; American Goldfinch, 10; Slate-coloured Junco, 2; Tree Sparrow, 54; Song Sparrow, 3; Snow Bunting, 75. Total 44 species, about 3,831 individuals. (Seen in area Dec. 18: Little Gull, 1; Bonaparte's Gull, 4; Brünich's Murre, 5.) G. Stirrett, A. Hyde, K. Edwards, I. Boardman, J. Argue, S. Peters,

R. Stewart (compiler), W. Lamb, A. Bell, J. Cartwright, I. Hyde, F. Phillips. (Kingston Nature Club Members).

**Brockville, Ont.** — (From Brockville to 4 miles west along the St. Lawrence River). — Dec. 29, 1952; 10:30 a.m.-4:30 p.m., cloudy, temperature 35°, wind 5-10 m.p.h.; total party-miles 9 (4 by car, 5 on foot) 2 observers. — Mallard, 5; Scaup, 300; Herring Gull, 11; Rock Dove, 10; Black-capped Chickadee, 6; White-breasted Nuthatch, 1; Starling, 4; English Sparrow, 37; Tree Sparrow, 17; (Seen recently in area, Hooded Merganser, 2; Am. Merganser, 7.) Total species 9, total individuals, 391. — D. Hurrie, H. Fisher.

**Rutherglen, Ont.** — (From 14 miles E of North Bay, township of Bonfield, villages of Bonfield, Rutherglen, Eau Claire, areas around Kaipuskong River, Pimisi Bay, Mattawa River, Pacaud Lake, Smith's Lake, Amable du Fond River, to 10 miles west of Mattawa, Ontario; open farmland 30%, coniferous woodlots and black spruce bog 10%, second growth mixed forest 50%, lakes and rivers 10%, settlements 10%). — Dec. 30; 7.30 a.m. to 4.30 p.m.; blue sky; 4° below to 11° above zero F.; wind SW, S. to E. 5 m.p.h.; ground covered with 5 to 6 inches soft snow; all fresh water except rapids and eddies frozen; total hours 9; total miles 42, (by car 33, on foot 9). — Am. Golden-eye, 13; Great Horned Owl, 1; Hairy Woodpecker, 11; Downy Woodpecker, 1; Blue Jay, 9; Northern Raven, 3; Black-capped Chickadee, 46; Red-breasted Nuthatch, 8; Brown Creeper, 2; Pine Grosbeak, 9; Common Redpoll, 7; Snow Bunting, 8. (Seen in the same vicinity Dec. 24: Ruffed Grouse, 1; Dec. 27: Common Starling, 1; Dec. 31: Pileated Woodpecker, 1.) Total species 12, about 118 individuals. — Louise de Kiriline Lawrence.

**Westport, Ont.** — (Leeds County — 7½-mile radius centering on the village municipal office, Westport. Farm land 15%, lakes 20%, marshes 6%, deciduous woodland 40%, mixed woodland 18%, red cedar groves 2%). Dec. 21, 8.00 a.m. to 5.30 p.m.; cloudy; temperature 20° to 30°; wind E, 10 to 15 m.p.h.; ground covered with 3 inches snow; marshes, lakes and some rivers frozen. — 6 observers in 4 parties. Total party-hours 14; total party-miles 52 (5 on foot, 47 by car). — Great Blue Heron, 1; Ring-necked Duck, 1; Bald Eagle, 1; Ruffed Grouse, 5; Herring

Gull, 12; Ring-billed Gull, 6; Rock Dove, 12; Kingfisher, 1; Yellow-shafted Flicker, 1; Pileated Woodpecker, 5; Hairy Woodpecker, 1; Downy Woodpecker, 8; Blue Jay, 4; Black-capped Chickadee, 139; White-breasted Nuthatch, 4; Starling, 9; English Sparrow, 65; Purple Finch, 1; Redpoll, 200; Slate-coloured Junco, 21; Tree Sparrow, 60. Total, 21 species; 557 individuals. — H. B. Arnold, D. Crawford, R. Hogoboam, R. Lockhart, A. M. Strong (compiler), J. Tett.

**Pickering Twp. (Ontario Co.), Ont.** — (15 acres of mixed woodland; white cedar 20%, poplar-birch-ironwood-maple 45%, uncultivated fields 15%). — Dec. 26; 7.30 a.m. to 4.30 p.m.; overcast; temp. 20° to 24°F.; wind W to NW, 10-15 m.p.h.; woods powdered lightly with snow; creek open; ice forming on still water. Three observers in 1 party. Total party-hours, 9; total party-miles 5 (on foot). — Red-tailed Hawk, 1; Ruffed Grouse, 1; Herring Gull, 6; Ring-billed Gull, 1; Hairy Woodpecker, 2; Downy Woodpecker, 4; Blue Jay, 10; Black-capped Chickadee, 15; White-breasted Nuthatch, 1; English Sparrow, 55; Cardinal, 4; Pine Siskin, 2; American Goldfinch, 10; Slate-coloured Junco, 15; Tree Sparrow, 4. Total 15 species; 131 individuals. — Adele Hearn, Doris H. Speirs, Dr. J. Murray Speirs.

**Lindsay, Ont.** — (Lindsay to Cambray and return following McLarens Creek and Scugog River, road 35%, field and pasture 30%, woods 35%). — December 21, 7.25 a.m. to 5.00 p.m.; temperature 23°-27°F.; 1 inch of snow, overcast, wind south-east 15 m.p.h. Total hours 9¾, total miles 35 (9 by car, 26 on foot). — Ruffed Grouse, 7; Mourning Dove, 1; Downy Woodpecker, 2; Blue Jay, 1; Red-breasted Nuthatch, 1; Black-capped Chickadee, 22; Golden-crowned Kinglet, 2; Common Starling, 6; English Sparrow, 30; Common Redpoll, 19; Pine Siskin, 4; Snow Bunting, 180. Total 12 species, 275 individuals. (Seen in area recently American Golden-eye, 1; Goldfinch, 1). — E. W. Calvert.

**Huntsville, Ont.** — December 21, 1952; 9.00 a.m. to 4.00 p.m.; mild; cloudy; light snow flurries; 6 inches of snow on ground; lakes and rivers mostly open; 7 observers in 6 parties. — Ruffed Grouse, 3; Herring Gull, 8; Hairy Woodpecker, 1; Blue Jay, 5; Black-capped Chickadee, 58; White-breasted Nuthatch, 7; Red-breasted Nuthatch, 10; Starling, 45; English Sparrow, 80; Pine Grosbeak, 3;

Siskin, 30; Snow Bunting, 150. Total 14 species; 406 individuals. — J. Goldthorp, C. Kay, A. May, K. Perrin, Mr. and Mrs. E. G. R. Rogers, R. J. Rutter (The Huntsville Nature Club).

**Hamilton, Ont.** — (As in past years, a 7½-mile radius centering on York and Dundurn Sts., and including Stoney Creek, Mount Hope Airport, Ancaster, Mineral Springs, West Flamboro, Lake Medad and Port Nelson; farmland 38%, city and suburbs 12%, mixed woods 38%, lake and bay 11%, cattail marsh 1%). — Dec. 21; 8 a.m. to 5.30 p.m.; overcast, dull, very light, intermittent drizzle, with heavy fog on upland areas; temp. 31° to 37°; wind NE, 9-14 m.p.h.; ground bare to 3 inches snow; all water open except upland ponds. Sixty-five observers in 27 parties. Total party-hours, 133 (126 on foot, 7 by car), total party-miles, 299 (199 on foot, 100 by car). — Common Loon, 1; Red-necked Grebe, 1; Horned Grebe, 1; Great Blue Heron, 2; Mute Swan, 2; Mallard, 108; Black Duck, 247; Redhead, 5; Canvas-back, 1; Greater Scaup, 925; Lesser Scaup, 4; Am. Golden-eye, 405; Buffle-head, 41; Old-squaw, 2; King Eider, 1; Hooded Merganser, 18; Am. Merganser, 2,000; Red-breasted Merganser, 47; Cooper's Hawk, 3; Red-tailed Hawk, 15; Rough-legged Hawk, 1; Bald Eagle, 1; Marsh Hawk, 1; Sparrow Hawk, 13; Ruffed Grouse, 15; Ring-necked Pheasant, 14; Killdeer, 2; Purple Sandpiper, 1 (J.B., W.G.); Glaucous Gull, 3; Iceland Gull (Kumlien's), 1; Great Black-backed Gull, 78; Herring Gull, 8,700; Ring-billed Gull, 700; Bonaparte's Gull, 1; Brünnick's Murre, 2 (plus 2 dead); Mourning Dove, 20; Screech Owl, 1; Horned Owl, 7; Long-eared Owl, 1; Belted Kingfisher, 6; Yellow-shafted Flicker, 7; Hairy Woodpecker, 25; Downy Woodpecker, 80; Blue Jay, 83; Crow, 2; Black-capped Chickadee, 474; White-breasted Nuthatch, 47; Brown Creeper, 22; Winter Wren, 9; Carolina Wren, 1 (J.B., W.G.); Robin, 1; Golden-crowned Kinglet, 38; Water Pipit, 1; Cedar Waxwing, 46; Common Starling, 2,000; House Sparrow, 2,600; Red-winged Blackbird, 1; Cardinal, 104; Evening Grosbeak, 1; Purple Finch, 22; Common Redpoll, 1; Pine Siskin, 145; Goldfinch, 104; Slate-colored Junco, 391; Tree Sparrow, 407; White-throated Sparrow, 2; Swamp Sparrow, 6; Song Sparrow, 26. Total 68 species; about 20,043 individuals. (Seen in area Dec. 14: Ruby-crowned Kinglet, 1; Dec. 19: Baldpate, 1; Dec. 20: Com-



mon Yellowthroat, 1; Dec. 26: Pied-billed Grebe, 1; Pintail, 3; Ring-necked Duck, 1; White-winged Scoter, 2; Am. Scoter, 1; Goshawk, 1; Purple Grackle, 1; Dec. 30: Snowy Owl, 1; Dec. 31: Green-Winged Teal, 1; Ivory Gull, 1; Black-legged Kittiwake, 1; Rusty Blackbird, 1; Jan. 1: Coot, 1; Ivory Gull, 2; Jan. 2: Myrtle Warbler, 1.) — Edith Austen, Jas. L. Baillie, Eric W. Bastin, W. E. Benner, Neil Bourne, R. D. F. Bourne, Stella Brown, F. W. Buckle, Don Bucknell, Alex. Burns, John D. Campbell, William I. Campbell, Winston Cheatley, Mrs. M. F. Clark, Sheila Clark, Janet Clarkson, K. J. Cox, John Cumming, D. Delzell, J. A. N. Dowall, R. O. Elstone, Dorothy Falladown, Leopold Fucikovsky, Leslie Gray, Miss L. Grightmire, W. W. H. Gunn, Ian Halladay, P. F. Henderson, Florence Holley, William R. Holley, Charles Hunter, Angus B. Jackson, H. E. Kettle, Barbara Laking, Leslie Laking, Margaret Lamb, H. Lemon, Betty LeWarne, Robert H. Lloyd, Ray N. Lowes, J. Mannheimer, C. Douglas McCallum, G. O. McMillan, Dorothy Jane Miller, John W. Moule, Gertrude Nelson, A. B. Nind, Laurel North, George W. North (compiler), Mrs. H. C. Nunn, James Nuttall, David K. Powell, Mrs. N. M. Robertson, Morley C. Sabine, Robert K. Sargeant, Eunice Smillie, Douglas Smith, Robert W. Smith, Laura Stewart, Gordon Sweatman, Anne Watson, Jane Watson, Mabel Watson, Mrs. M. R. Watters, J. H. Williams (Hamilton Nature Club).

**Kitchener and Waterloo, Ont.** — (Dec. 28 8.30 a.m. to 5 p.m., 22°-32°, wind 15-20 m.p.h., sparse snow, open water; 15 observers, 35 party-hours—37 party-miles. — Mallard, 14; Black Duck, 18; Amer. Merganser, 1; Ruffed Grouse, 21; Ring-necked Pheasant, 3; Herring Gull, 11; Rock Dove, 24; Belted Kingfisher, 1; Hairy Woodpecker, 8; Downy Woodpecker, 35; Blue Jay, 22; Crow, 1; Black-capped Chickadee, 180; White-breasted Nuthatch, 23; Red-breasted Nuthatch, 4; Brown Creeper, 28; Winter Wren, 4; Hermit Thrush, 1; Golden-crowned Kinglet, 74; Northern Shrike, 1; Starling, 40; English Sparrow, 435; Rusty Blackbird, 1; Cardinal, 22; Redpoll, 146; Pine Siskin, 26; Goldfinch, 45; Slate-coloured Junco, 67; Tree Sparrow, 52; Snow Bunting, 56; (Birds seen recently, Red-shouldered Hawk 2; American Rough-legged Hawk, 1; Red-tailed Hawk, 1; Screech Owl, 1; Brown-capped Chickadee, 1). Total 36 species, 1,377 individuals. — Robert Pickering, Len Wambold, James Detweiler, F. W. R. Dickson,

Willard Schaefer, Glen Schaefer, Peter Smith, Mr. Campbell, Craig Campbell, Morley Preston, Russel Tilt, Eric M. Carter, Richard Hilborn, Clarence Bingham, Margaret Lemon.

**Port Arthur-Fort William, Ont.** — 7½ miles radius with Bare Point Chippewa Park, Carters Corner and Intolo P.O. being the main points on the perimeter). December 26; 9 a.m. to 5.30 p.m.; overcast in a.m. clearing in p.m.; temperature 23° to 3°F., wind north-west 12-16 m.p.h., relative humidity was 81% in a.m.; snow up to 3 inches; 36 observers in 14 parties; total party-hours 36, total party-miles 195 (164 by car, 31 on foot). — Mallard, 4; Black Duck, 76; Marsh Hawk, 1; Ruffed Grouse, 7; Hungarian Partridge, 8; Herring Gull, 47; Rock Dove, 299; Horned Owl, 2; Hairy Woodpecker, 2; Downy Woodpecker, 5; Canada Jay, 8; Blue Jay, 10; Raven, 24; Crow, 5; Black-capped Chickadee, 118; Brown-capped Chickadee, 5; Red-breasted Nuthatch, 13; Starling, 242; English Sparrow, 759; Evening Grosbeak, 39; Pine Grosbeak, 654; Common Redpoll, 379; Pine Siskin, 23; Red Crossbill, 8. Total 24 species, 2,737 individuals. (Seen recently: Am. Golden-eye, 2; Snowy Owl, 1; Pileated Woodpecker, 1; Brown Creeper, 1; Bohemian Waxwing, 23; Cedar Waxwing, 23; Purple Finch, 1; Tree Sparrow, 1). — Mr. & Mrs. P. Addison and sons Edward, Peter and William, Dr. A. E. Allin and son David, M. J. Armstrong, Mr. & Mrs. R. M. Beckett, Mr. & Mrs. W. D. Beckett, David Bianco, C. Brown, K. Denis (compiler) and children Norman and Betty, Mr. & Mrs. Ken Eoll, H. K. Campbell, Captain A. E. Fader, C. E. Garton, Mr. & Mrs. J. Hanton, Mrs. W. M. Knowles, Mr. & Mrs. J. Murie, Dr. & Mrs. H. Quackenbush, W. Robinson, Mrs. C. Rydhalm & children Louise and Laurie, I. Sherlock, L. Slichter, J. Thompson. (Thunder Bay Field-Naturalists' Club).

**Yorkton, Sask.** — 7½-mile radius centering on Yorkton; same area as previous years). — Dec. 26; 9 a.m. to 5 p.m.; overcast; temp. 11° to 22°; wind SSE to NE, 10-12 m.p.h.; ground covered with 2 inches snow; 24 observers in 6 parties; total party-hours, 27 (17 on foot, 10 by car); total party-miles, 133 (29 on foot, 104 by car). — Ruffed Grouse, 6; Sharp-tailed Grouse, 52; Hungarian Partridge, 18; Great Horned Owl, 2; Hairy Woodpecker, 1; Downy Woodpecker, 6; Canada Jay, 1; Blue Jay, 1; Magpie, 30; Black-capped Chickadee, 63; Robin, 1; Bohemian Wax-

wing, 29; English Sparrow, 1,030; Brewer's Blackbird, 1; Pine Grosbeak, 15; Common Redpoll, 96; Slate-coloured Junco, 1; Snow Bunting, 520. Total 18 species, approximately 1,873 individuals. (Seen in area Dec. 24: Snowy Owl, 1). — Norma Beck, Henry Chilman, Brother Clarence, Lionel Coleman, Ronald Coleman, Dr. C. J. Houston, Dr. and Mrs. Stuart Houston, Mr. and Mrs. C. W. Lightbody, Allan Nurse, Jack Park, Tony Pawluck, Gordon Pearce, Greg Pearce, Irving Pearce, Wayne Pearce, Ray Riesz, Cliff Shaw, Jeff Smith, Frank Switzer, Gillian Switzer, Darcy Wershler, Merril Wershler (Yorkton Natural History Society).

**Saskatoon, Sask.** — (10-mile radius, including Sutherland). December 24, 1952; 8.15 a.m. to 2 p.m.; partly cloudy 5°F; 1-2 inches of snow; hoar frost on trees; 2 observers; total miles 74 (71 by car, 3 on foot). — Mallard, 1; Am. Golden-eye, 2; Goshawk, 3; Sharp-tailed Grouse, 8; Hungarian Partridge, 39; Snowy Owl, 4; Blue Jay, 2; Magpie, 11; Black-capped Chickadee, 4; Bohemian Waxwing, 31; English Sparrow, 875; Pine Grosbeak, 4; Redpoll, 405; Slate-coloured Junco, 4; Snow Bunting, 250. (December 27: Ring-necked Pheasant, 2; January 1: Great Horned Owl, 1). Total 15 species; 1,643 individuals. — F. J. H. Fredeen, J. B. Gollop.

**Calgary, Alta.** — (4-mile radius of Inglewood Bird Sanctuary along the Bow and Elbow River). Dec. 27, 1952; 2.00 p.m. to 4.00 p.m.; temperature 16°-18°F.; wind N.W. to N. 4 m.p.h.; no snow; rivers and lakes free of ice; 14 observers; total party-hours 28; total party-miles 36 on foot. — Canada Goose, 8; Lesser Canada Goose, 22; Mallard, 2,370; Am. Golden-eye, 120; Redhead, 1; Bufflehead, 9; Am. Merganser, 21; Goshawk, 5; Ring-necked Pheasant, 12; Rock Dove, 27; Hairy Woodpecker, 2; Downy Woodpecker, 1; Magpie, 42; Black-capped Chickadee, 25; Cedar Waxwing, 55; Starling, 40; English Sparrow, 26; Common Redpoll, 19; Hoary Redpoll, 2; Pine Siskin, 3. (Seen recently in area, Common Loon, 2; Killdeer, 5; Downy Woodpecker, 1; Brown Creeper, 1; Golden-crowned Kinglet, 6; Great Northern Shrike, 1; Loggerhead Shrike, 1; Evening Grosbeak, 7). Total species 20; total individuals, 2,810. — N. Winnick, G. Steen, C. G. Hampson, W. R. Salt, M. J. Cope, A. Robinson, J. C. Barnhardt (Calgary Naturalists Club).

**Vernon, B.C.** — (West to Okanagan Landing, north to Buckerfields Ranch, south to

Kalamalka Lake and east to Coldstream Ranch). — Dec. 28, 1952; 9.00 a.m. to 3.00 p.m.; overcast with scattered snow flurries in afternoon; wind light; temp. 30° to 35°; one and a half inches of snow; Okanagan and Kalamalka Lakes clear of ice; Swan Lake frozen over; 9 observers in 3 parties; total miles by car approx. 45; on foot 10. — Horned Grebe, 2; Western Grebe, 4; Great Blue Heron, 1; Mallard, 171+; Pintail, 1; Green-winged Teal, 3; Baldpate, 106+; Redhead, 56; Lesser Scaup, 14; Common Golden-eye, 17; Am. Merganser, 5; Sharp-shinned Hawk, 2; Sparrow Hawk, 2; Ruffed Grouse, 1; European Partridge, 17; Ring-necked Pheasant, 132+; Am. Coot, 450+; Killdeer, 11; Wilson's Snipe, 11; Herring Gull, 2; Pygmy Owl, 1; Short-eared Owl, 8; Belted Kingfisher, 2; Red-shafted Flicker, 37; Hairy Woodpecker, 1; Downy Woodpecker, 3; Steller's Jay, 8; Black-billed Magpie, 13; Raven, 3; Clark's Nutcracker, 1; Black-capped Chickadee, 126; Mountain Chickadee, 1; Red-breasted Nuthatch, 7; Brown Creeper, 1; Dipper, 4; Winter Wren, 1; Long-billed Marsh Wren, 1; Robin, 29; Townsend's Solitaire, 3; Golden-crowned Kinglet, 20; Bohemian Waxwing, 1,939+; Cedar Waxwing, 4; Northern Shrike, 5; English Sparrow, 318+; Western Meadowlark, 55; Brewer's Blackbird, 7; Evening Grosbeak, 159; Pine Grosbeak, 27; Common Redpoll, 156+; American Goldfinch, 31; Oregon Junco, 418+; Tree Sparrow, 11; White-crowned Sparrow, 38; Song Sparrow, 32. Total 54 species, 4,478 (approx.) individuals. (Seen during period: Gyrfalcon, 1; Mourning Dove, 40; Horned Lark, 40; *Leucosticte*, 7; Snow Bunting, 40). — J. B. Beddome, D. K. Campbell, J. T. Fowle, J. Grant, A. N. Humphries, J. Quirk, G. Peacock, B. A. Sugden.

**Hope, B.C.** — (Kawkawa Lake). — December 27, 1952; 10.30 a.m. to 3.00 p.m.; overcast, mild; total hours, 9; total miles, 4 on foot. — Western Grebe, 2; Pied-billed Grebe, 1; American Golden-eye, 3; Cooper's Hawk, 1; American Coot, 1; Pileated Woodpecker, 1; Hairy Woodpecker, 1; Black-capped Chickadee, 11; Winter Wren, 6; Ruby-crowned Kinglet, 12; Evening Grosbeak, 17; Pine Siskin, 15; Oregon Towhee, 2. Total 13 species; 73 individuals. — Mrs. R. M. Mason, Miss Marie Mason, R. Houlden.

**Vancouver, B.C.** — (North Arm of Fraser River near Point Grey Golf course; S.W. Corner of Sea Island; Stanley Park; Burrard

Inlet, Cassiar to Willingdon Streets; Mt. Seymour Highway, North Vancouver). — Dec. 28, 1952; 10.00 a.m. to 4.00 p.m.; strong south-westerly wind with rain squalls; 13 observers in 5 parties; 2 feeding station observers; total hours, 35; total miles, 12 on foot. — Horned Grebe, 2; Western Grebe, 30; Brandt's Cormorant, 1; Baird's Cormorant, 4; Great Blue Heron, 4; Mallard, 200; Pintail, 2,025; Baldpate, 100; Shoveller, 25; Scaup Duck, 29; Golden-eye, 206; Buffle-head, 25; White-winged Scoter, 42; Surf Scoter, 150; Red-breasted Merganser, 53; Hooded Merganser, 8; Sharp-shinned Hawk, 1; Coot, 50; Glaucous-winged Gull, 105; Herring Gull, 49; Short-billed Gull, 41; Red-shafted Flicker, 8; Steller's Jay, 1; Northwestern Crow, 10; Black-capped Chickadee, 60; Chestnut-backed Chickadee, 32; Winter Wren, 3; Bewick's Wren, 2; Robin, 42; Varied Thrush, 5; Golden-crowned Kinglet, 200; Ruby-crowned Kinglet, 1; Western Meadowlark, 6; Brewer's Blackbird, 7; Evening Grosbeak, 100; Purple Finch, 24; Oregon Towhee, 29; Oregon Junco, 55; Fox Sparrow, 1; Song Sparrow, 37. Total 40 species; 3,773 individuals. — Mr. & Mrs. S. F. Bradley, Miss Christine Bramley, Mrs. F. Morgan, Miss Heather Gower, Mr. & Mrs. F. Waugh, Mrs. F. McGinn, Mr. & Mrs. G. B. H. Stevens, C. F. Gough, F. J. Sanford and R. H. Mackay (Vancouver Natural History Society).

**Race Rocks Lightstation, B.C.** — (12 miles southwest of Victoria B.C.); rocky island with grass the only vegetation; approx. area 6 acres; nearest wooded island  $\frac{1}{2}$  mile distant. — Jan. 1, 1953; 9.00 a.m. to 4.00 p.m.; temp. 42° to 45°F.; wind S.E. 5 m.p.h.; cloudy, sea smooth, no snow on ground; 2 observers; since area so limited repeated circuits of the island were made on foot and the figures given are the maximum seen on a single circuit of the island for each species. — Horned Grebe, 1; Brandt's Cormorant, 20; Pelagic Cormorant, 25; unidentified cormorants, 65; Harlequin Duck, 7; White-winged Scoter, 5; Surf Scoter, 15; Black Oystercatcher, 21; Black Turnstone, 30; Hudsonian

Curlew, 1; Aleutian Sandpiper, 20; Divers (probably mostly Common Murres), 200 plus; Glaucous-winged Gull, 20; Short-billed Gull, 20; Herring Gull (Thayers?), 14; unidentified gulls, 300 plus; Song Sparrow, 1. (Seen during period, Double-crested Cormorant, Black Brant). — Total 15 species, 709 individuals. — G. C. and J. M. Odum.

**Comox, B.C.** — (From  $\frac{1}{2}$  mile east of Comox Wharf along shore line and Courtenay River to Condensory Bridge in Courtenay). — January 1; 9.00 to 4.15 p.m.; overcast in p.m.; very dark, calm; temperature 26° to 40°F. — Common Loon, 10; Holboell's Grebe, 5; Eared Grebe, 11; Western Grebe, 1; Double-crested Cormorant, 5; Pelagic Cormorant, 2; Unidentified Cormorants, 5; Great Blue Heron, 2; Mallard, 450; Gadwall, 3; Baldpate, 350; Pintail, 136; Green-winged Teal, 11; Canvas-back, 4; Scaup, (probably both species) 335; Am. Golden-eye, 150; Barrow's Golden-eye, 4; Buffle-head, 50; Oldsquaw, 1; White-winged Scoter, 350; Surf Scoter, 75; Unidentified Scoters, 700; Ruddy Duck, 1; Hooded Merganser, 3; Am. Merganser, 7; Red-breasted Merganser, 2; Black Pigeon Hawk, 1; Bald Eagle, 1; California Quail, 8; Ring-necked Pheasant, 2; Coot, 18; Killdeer, 3; Black Turnstone, 3; Glaucous-winged Gull, 500; Thayer's Gull, 1; Short-billed Gull, 25; Short-eared Owl, 1; Belted Kingfisher, 2; Flicker, 9; Pileated Woodpecker, 1; Harris' Woodpecker, 2; Gairdner's Woodpecker, 1; Steller's Jay, 5; Raven, 5; Western Crow, 2; Northwestern Crow, 400; Chestnut-backed Chickadee, 35; Seattle Wren, 6; Robin, 26; Varied Thrush, 3; Golden-crowned Kinglet, 9; English Sparrow, 7; Meadowlark, 1; Red-winged Blackbird, 6; Brewer's Blackbird, 80; Purple Finch, 25; Oregon Towhee, 9; Oregon Junco, 50; Savannah Sparrow, 1; Song Sparrow, 25. (Seen in area recently, Pacific Loon; Black Brant; Am. Scoter; Sharp-shinned Hawk; California Murre; Marbled Murrelet; Townsend's Solitaire; Ruby-crowned Kinglet; Northern Shrike; Pine Siskin). Total species 59, individuals 3,626. — R. Fryer, D. Guthrie, Theed Pearse.

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# A PLANT COLLECTION FROM THE WEST SIDE OF BOOTHIA ISTHMUS, N.W.T., CANADA <sup>1 2</sup>

W. J. CODY

During the period May 18 to August 16, 1951, Mr. J. G. Chillcott conducted a biological investigation on the west coast of Boothia Isthmus, in the vicinity of the settlement of Spence Bay (approx. 69°30'N 93°30'W). The work was part of the Northern Insect Survey undertaken by the Division of Entomology, Canada Department of Agriculture in cooperation with the Defence Research Board, Canada Department of National Defence. In addition to a large collection of insects, a representative set of specimens of the flora of the area was secured.

Although some two-thirds of Boothia Peninsula lies east of the 95th meridian, the western limit of his Flora, Polunin excluded the whole peninsula from the Botany of the Canadian Eastern Arctic<sup>3</sup>, presumably because of lack of specimens from that area. Boothia Peninsula is also outside the range of the Report of the Canadian Arctic Expedition 1913-1918<sup>4</sup>.

Mr. Chillcott's well-prepared collection of plants from this little known area should not go unrecorded. This paper lists the entities gathered by him, together with his notes on their frequency and habitat.

The 1950 edition of the 8 mile to 1 inch Rae Strait map sheet published by the Canada Department of Mines and Technical Surveys, shows the Franklin-Keewatin boundary as passing just north of the settlement of Spence Bay, thus placing the settlement in the District of Keewatin. The Northwest Territories Administration has advised, however, that the boundary runs along the south shore of Spence Bay several miles south of the settlement. Therefore, with the exception of a few specimens which were collected at Lady Melville Lake south of the border, all the specimens listed below were collected in Franklin District.

## POLYPODIACEAE

WOODSIA GLABELLA R. Br. — fairly common in crevices on granite hills one mile north of the settlement, 37.

## EQUISETACEAE

EQUISETUM VARIEGATUM Schleich. — fairly common on wet moss hummocks in marsh, 90.

## GRAMINEAE

HIEROCHLOE ALPINA (Sw.) R. & S. — in crevices in granite hill one mile north of settlement, 41.

HIEROCHLOE PAUCIFLORA R. Br. — common in wet marshy ground, 31, 57, 81.

ARCTAGROSTIS LATIFOLIA (R. Br.) Griseb. — common on hummocks of temporary pools and in wet marshy ground, 76, 87, 96.

POA ARCTICA R. Br. — common on dry mossy tundra, 72, 74.

DUPONTIA FISHERI R. Br. — in old stream valley among moss hummocks and in wet marshy ground, 71, 77, 92.

PUCCINELLIA PHRYGANODES (Trin.) Scribn. & Merr. — restricted to marine sandy shore, 94

FESTUCA BAFFINENSIS Polunin — fairly well distributed on dry heath tundra hillside, 79.

## CYPERACEAE

ERIOPHORUM RUSSEOLUM Fries var. LEUCOTHRIX (Blomgr.) Hult. — wet mossy edge of pool, uncommon, 91.

ERIOPHORUM ANGUSTIFOLIUM Honckeny — fairly common in moist tundra valley and in old overflow pool bottom, 55, 62.

KOBRESIA HYPERBOREA A. E. Porsild — in heath tundra on hillside, uncommon, 89.

CAREX ATROFUSCA Schk. — uncommon in wet marshy ground, 82.

CAREX MISANDRA R. Br. — in wet marshy spring flooded ground and on wet hummocks by streams and lakes, 58, 61, 75A, 80, 99.

CAREX BIGELOWII Torr. — fairly uncommon in *Carex* marsh near stream, 73.

CAREX STANS Drej. — common in wet marshy ground, 84, 86, 97.

CAREX MEMBRANACEA Hook. — common in wet marshy ground and moist moss hummocks along borders of streams, 54, 85, 98, 100.

<sup>1</sup> Contribution No. 1181 from the Division of Botany and Plant Pathology, Science Service, Canada Department of Agriculture, Ottawa.

<sup>2</sup> Received for publication, May 8, 1952.

<sup>3</sup> Polunin, N., Botany of the Canadian Eastern Arctic Part 1 — Pteridophyta and Spermatophyta, Canada Department of Mines and Resources, National Museum Bulletin No. 92, 1940.

<sup>4</sup> Macoun, J. M. and Th. Holm, The Vascular Plants of the Arctic Coast of America west of the 100th Meridian, collected by the Canadian Arctic Expedition 1913-18, vol. V: Botany, part A: Vascular Plants, 1921.

**JUNCACEAE**

LUZULA NIVALIS (Laest.) Beurl. — common in wet marshy spring-flooded land, 78.

LUZULA CONFUSA Lindb. — common in deep moss in rock crevices, 88.

JUNCUS BIGLUMIS L. — rare, scattered in wet marshy ground, 83.

**SALICACEAE**

SALIX RETICULATA L.—creeping on moist hummocks, 28.

SALIX ARCTICA Pall. var. BROWNEI Anderss. — fairly abundant on hummocks in wet sedge marsh near settlement, 3♀, 4♂, 29♀; prostrate on mossy quite rocky upland tundra, one mile east of settlement, 8♂; creeping on well-drained upland tundra three miles northwest of settlement, 20A♀, 20B♂. SALIX ARCTOPHILA Cockerell—dry tundra on edge of valley stream one mile south of settlement, 64♀.

SALIX RICHARDSONII Hook. — common on grassy stream bank, 69.

**POLYGONACEAE**

OXYRIA DIGYNA (L.) Hill—very common in moist sand of long sand spit four miles north of settlement, but only occasional in the dry lichen tundra near the settlement, 9A, 9B.

POLYGONUM VIVIPARUM L.—common in moist tundra near edge of pool and among mosses on stream bank, 51A, 51B.

**CARYOPHYLLACEAE**

SILENE ACAULIS L. var. EXSCAPA (All.) DC. — not common on moist sandy lichen tundra three miles northwest of settlement, and also in coarse gravel on long spit four miles northwest of settlement, 1B, 11.

LYCHNIS APETALA L. var. arctica (Fries) stat. n. *Wahlenbergella apetalata* β *arctica* Fries, Öfvers. Vet. Akad. Förh. 133. 1869 (non vidi). *Lychnis apetalata* L. var. *nutans* Boivin, Can. Field-Nat. 65:5. 1951.—common on moss hummocks in wet sedge marsh, 43. At the varietal level var. *arctica* appears to be the oldest available epithet for the arctic phase of *Lychnis apetalata*. This necessitates the following transfer: *Lychnis apetalata* L. var. *arctica* (Fries) Cody forma *palea* (Pol.) stat n., *Lychnis apetalata* L. forma *palea* Pol., Contr. Gray Herb. 165:97. 1947. This form is not yet known to be present in our area, indeed, it is only known from the type locality (Coral Harbour, Southampton Island) and

one other locality, (east end of Baker Lake, Keewatin District, D.B.O. Savile & C. T. Watts 1487).

CERASTIUM ALPINUM L. — quite common on dry upland tundra east of the settlement, 46B, 51.

STELLARIA LAETA Rich. — rare on moist upland tundra three miles northwest of settlement, 18.

STELLARIA MONANTHA Hulten var. MONANTHA — generally distributed in gravelly sand on long sandy spit four miles northwest of settlement, 17.

STELLARIA sp.—quite abundant in patches in dry upland tundra meadow two miles east of settlement, 46A. This is a third entity which I have been unable to place in Hultén's recent treatment of the *Stellaria longipes* group. The entire plant is glabrous; the leaves are dull and glaucous, somewhat carinose, ovate to lanceolate; scarious bracts are present; and the stems are many-flowered. Hultén, who has seen a duplicate, reports in litt: "It has the general appearance of *S. crassipes* but several characteristics of *S. longipes* such as several flowers, very acute leaves and quadrangular stem. Apparently intermediates occur, probably not so rarely." Our plant is quite possibly of hybrid origin. ARENARIA ROSSII R. Br. var. DAETHIANA Polunin—moist moss hummocks at edge of lake, rare, 56.

**RANUNCULACEAE**

RANUNCULUS HYPERBOREUS Rottb. — wet sand on ocean shore, 59.

RANUNCULUS NIVALIS L.—only scattered plants on moss hummocks at edge of lake, Lady Melville Lake, 69°25'N 93°15'W, 22

RANUNCULUS SABINEI R. Br. — fairly rare in moist moss hummock near lake, Lady Melville Lake, 69°25'N 93°15'W, 25

**PAPAVERACEAE**

PAPAVER RADICATUM Rottb.—fairly common in gravelly sand on long sandy spit four miles northwest of settlement but rare elsewhere, 10.

**CRUCIFERAE**

COCHLEARIA OFFICINALIS L. var. GROENLANDICA (L.) Gelert — rare on sandy ground at edge of seashore near the settlement, 93; fairly common on high gravelly tundra six miles southwest of settlement, 24; uncommon on moist gravelly beach

at tip of long point of land six miles southwest of settlement, 68.

*EUTREMA EDWARDSII* R. Br. — in moist sedge meadows and on moss hummocks at edge of lake, 34, 49.

*CARDAMINE PRATENSIS* L. — rare on mossy edge of pool, 44.

*DRABA ALPINA* L. — common on upland tundra two miles north of settlement and generally distributed in gravelly sand on long sand spit four miles northwest of settlement, 35, 21.

*DRABA SUBCAPITATA* Simmons — uncommon in gravelly sand on long sand spit four miles northwest of settlement, 14.

*DRABA FLADNIZENSIS* Wulfen var. *HE-TEROTRICA* (Lindblom) Ball — fairly common on dry upland tundra, 30.

*PARRYA ARCTICA* R. Br. — common on upland tundra, 32.

*PARRYA ARCTICA* R. Br. f. *albiflora* Boivin f. n. *petalis albis* — common on sloping upland tundra, 33; *Sweetman & Smith* 6, Cambridge Bay, 69°03'N, 104°50'W, dampish area surrounded by *Carex*, July 2, 1950 (type); *J. Woodruff* 96, King William Island, 68°47'N, 97°40'W, Aug. 10, 1949.

#### SAXIFRAGACEAE

*SAXIFRAGA CERNUA* L. — common on dry mossy tundra, 70.

*SAXIFRAGA CAESPITOSA* L. — in a mat on granite ledge one mile north of settlement, 42.

*SAXIFRAGA HIERACIFOLIA* Waldst. & Kit. — in moist earth on south side of tundra hill, 40B.

*SAXIFRAGA NIVALIS* L. — in rock crevices in granite hill one mile north of settlement, 40A.

*SAXIFRAGA AIZOIDES* L. — dry upland heath tundra eight miles south of settlement; uncommon except in this place, 66.

*SAXIFRAGA TRICUSPIDATA* Rottb. — on rock ledge; of very common occurrence everywhere, 47.

*SAXIFRAGA HIRCULUS* L. — quite rare in deep sedge marsh, Lady Melville Lake, 65°25'N, 93°15'W, 23A; common on moist tundra and in swampy places about the settlement 23B.

*SAXIFRAGA OPPOSITIFOLIA* L. — quite common throughout the district, 1A.

*CHRYSOPLERIUM IOENSE* Rydb. — mostly hidden in wet moss at edge of pool, 5. The specimens of this collection have among other characters, 8 stamens and are there-

fore referred here rather than to the common northern *C. tetrandum*. (Rosendahl, *Rhodora* 49: 25-36. 1947.)

#### ROSACEAE

*POTENTILLA RUBRICAULIS* Lehmann — generally distributed on moist upland tundra three miles northwest of settlement, 15.

*POTENTILLA VAHLIANA* Lehmann — in rock crevices in granite hills one mile north of settlement, 38.

*DRYAS INTEGRIFOLIA* M. Vahl — common throughout the district on well-drained upland tundra, 19.

#### LEGUMINOSAE

*ASTRAGALUS ALPINUS* L. — occasional on tundra hummocks near water one mile northeast of settlement, 45.

*OXYTROPIS MAYDELLIANA* Trautv. — generally common on moist sandy tundra three miles northwest of settlement, 12.

*OXYTROPIS ARCTOBIA* Bunge — common on shale limestone tundra, 7.

#### ONAGRACEAE

*EPILOBIUM LATIFOLIUM* L. — common on dry tundra and often in old stream beds, 52.

*EPILOBIUM DAVURICUM* Fisch. var. *ARCTICUM* (Samuelsson) Polunin — in moss at moist edge of pool, 63.

#### ERICACEAE

*CASSIOPE TETRAGONA* (L.) D. Don — dry tundra on valley sides, 60.

#### PLUMBAGINACEAE

*ARMERIA MARITIMA* (Mill.) Willd. var. *SIBIRICA* (Turcz.) Lawr. — very rare in old lake bed in sedge valley eight miles south of settlement, 67.

#### SCROPHULARIACEAE

*PEDICULARIS SUDETICA* Willd. — common on wet sedge meadow, 27.

*PEDICULARIS LANATA* Cham. & Schl. — fairly common on rocky tundra, 6.

*PEDICULARIS LANGSDORFFII* Fisch. — common on moist hummocks in sedge marsh, 26.

*PEDICULARIS CAPITATA* Adams — fairly common on moist lichen tundra, 39.

#### COMPOSITAE

*MATRICARIA AMBIGUA* (Ledeb.) Karyl. — restricted to marine sandy shore, 95.

*CHRYSANthemum INTEGRIFOLIUM* Rich. — often in old stream beds and on upland

tundra, one mile southeast of settlement, 53. **TARAXACUM LACERUM** Greene — restricted to gravelly sand on long sand spit four miles northwest of settlement, 16.

The specimens are preserved in the Herbarium of the Division of Botany, and Plant Pathology, Science Service, Canada Department of Agriculture, Ottawa.

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## NOTES AND OBSERVATIONS

**Clay-colored Sparrow nesting in Grey County, Ontario.** — During a field day held by the Toronto Field Naturalist Club on the 24th of May week-end 1952, at Craigleith in Grey County, Ont., a singing Clay-colored sparrow (*Spizella pallida*) was discovered by a member of the party — George Francis of Toronto, Ont. The writer made several visits to the location, an old pasture field overgrown with hawthorn bushes, wild roses bushes and wild apple, a typical habitat for this western sparrow, and discovered a colony of this species, some three or four pairs. On June 12, 1952, the writer found a Clay-colored Sparrow nesting, in a wild rose bush eight or ten inches from the ground in this locality with a singing male in attendance a few yards from the nesting female. A colored photograph was secured of the nest and four eggs. While the Clay-colored Sparrow has been recorded twice in an adjacent county — Simcoe County (no nesting record) — this apparently is the first record of the Clay-colored Sparrow nesting in Grey County. **A. J. MITCHENER**, 73 Market St., Collingwood, Ont.

**Recent Records of the Magpie in Northwestern Ontario.**—Peterson (1947) considers the Magpie, *Pica pica*, to be a straggler in eastern North America. A northeastern spread of the range of this species occurred in 1944-45, according to Rand (1948). The effects of this spread seem to have persisted, judging by records reported to the Department of Lands and Forests, Sioux Lookout, during the past two years.

Mr. Frank Dodds, now of Red Lake, and a resident of the Ghost-River—Sioux Lookout—Red Lake area for over 30 years, stated that there is an occasional fall flight of magpies in this area. He has seen them on three occasions, and has heard of two or three birds being seen each time.

Mr. T. Batchelor, now of Sioux Lookout, saw a magpie in the fall of 1944 (year?) at Big Beaverhouse Lake, to the north of Pickle Lake. Later that winter, an Indian trapped

a magpie nearby, which he showed to Mr. Batchelor at the trading post.

Mr. C. L. Perrie told me that a commercial fisherman, Mr. Vic Parks, reported seeing three magpies at Oneman Lake, north of Kenora, in 1949. The birds appeared in November, then left singly, and the last had gone before January.

Mr. E. Stone, now of Sioux Lookout, fished commercially near Minaki during the winter of 1949-50. He relates that that winter, probably in January, between 15 and 20 magpies came to Sand Lake, and stayed there for a period of about 10 days, feeding on cull fish. It was the first time that anyone around Minaki had seen magpies, and none has been seen there since.

In March, 1951, two magpies were trapped near Kenora. One was taken into the local Department of Lands and Forests office for examination, but the specimen was not saved.

During December, 1951, an Indian trapper, David Brisket, trapped a magpie near Highstone Lake 30 miles northeast of Sioux Lookout. The specimen was turned over to the Royal Ontario Museum of Zoology.

A magpie was seen on October 28, 1952, at Ghost River, by Mr. T. Zarecki, a trapper. This last record makes 1952-53 the fourth consecutive winter during which the magpie has been reported in northwestern Ontario.

There is little doubt the magpie is now more than a mere straggler in northwestern Ontario and deserves to be classified as either a regular, or irregular, but rare fall and winter visitant in the area.

Most of the above records have come from either trappers or commercial fishermen. A potential winter-round supply of magpie food results from the efforts of both these groups of workers, and so it is quite probable that these winter magpie records will increase in frequency. If so, this species will become increasingly interesting to naturalists of northwestern Ontario.



### Literature Cited

- Peterson, R. T., 1947. A field guide to the birds. Houghton Mifflin Co., Boston.  
 Rand, A. L., 1948. Distributional notes on Canadian Birds. Can. Field-Nat. 62 (6): 175-180.

A. T. CRINGAN,  
 Ont. Dept. of Lands and Forests,  
 Sioux Lookout, Ont.

**Starling nesting at Churchill, Manitoba.**—In 1952, European Starlings (*Sturnus vulgaris*) extended their nesting range in Manitoba as far north as Churchill. This seaport town, at 58° 45' N. Lat., is probably the most northerly point on this continent at which starlings have yet nested.

Since 1944, when Dr. Arthur Allen reported having seen 4 Starlings at Churchill, occasional strays have been observed in this region, but not until this year has there been any evidence of their nesting here.

On May 10, 1952, I saw a flock of 17 Starlings near the Churchill grain elevator, and early in June noted that these birds had built nests high up (60-70 ft.) in the structural steel that supports the grain conveyor between the elevator and the shipping docks. There were eight nests at least, perhaps more, loosely constructed of grasses. Only one brood was raised this season. When the young were able to fly, the total number of birds, young and old, was approximately 60. This flock, which has so far had few casualties, is still here (November 12, 1952) although northern winter set in grimly some weeks ago. It appears that they have come to stay.—MRS. EVA BECKETT, Churchill, Man.

**Dead Golden Eagle at Perkins Mills, Quebec.**—On February 24, 1949, R. Frith and I found a dead Golden Eagle, *Aquila chrysaetos canadensis* (Linnaeus), in the Ottawa District near Perkins Mills, Quebec. It was on a fence-post by the road from Ste. Rose de Lima. To judge from tracks in the snow, someone had recently crossed the roadside snowdrift and fence, gone a short distance into pine woods, picked up the bird from the snow, and placed the carcass on the fence-post. When found, both feet had been chopped off at the body and removed and one wing was gone. On dissection, the flesh of the carcass was found to be partly decomposed, the internal organs, largely so.

Left wing and back bone were shattered, probably by a rifle bullet. It seems probable that it was shot near where found, although

this is not certain. If it had been shot elsewhere and then discarded from a vehicle on the road, it seems most unlikely that anyone would carry it across drift and fence to leave it in the woods beyond. The tail, skull, and a piece of breast-skin with feathers attached were saved.—HOYES LLOYD, Ottawa.

**White-tailed Deer *Odocoileus virginianus* in Jasper National Park, Alberta.**—I observed a young doe white-tailed deer on May 23, 1952, near the junction of the Miette and Athabasca Rivers, two miles south of Jasper. The only previous record was a doe seen by Warden B. White at Decoigne during July, 1943, according to Cowan (Report on game conditions in Banff, Jasper, and Kootenay National Parks, 1943. National Parks Bureau, Ottawa, 72 pp., mimeographed).

There is a summer influx of white-tailed deer near Mount Eisenhower and Saskatchewan River Crossing, Banff National Park. These areas are opposite low passes through the Rocky Mountains leading to the Columbia River Valley of British Columbia where the northwestern white-tailed deer *Odocoileus virginianus ochrourus* is common according to Cowan (Distribution and variation in deer (genus *Odocoileus*) of the Pacific coastal region of North America. Calif. Fish and Game 22 (3): 156-246, 1936).

It is noteworthy that the deer observed in Jasper were opposite the Yellowhead Pass. Undoubtedly these deer belonged to the subspecies *ochrourus*.—A. W. F. BANFIELD, Canadian Wildlife Service, Banff, Alberta.

**Starlings in the Ungava District, Quebec Province.**—During the summer of 1952, the writer was engaged in herpetological studies of northeastern Canada under the auspices of the Arctic Institute of North America. From July 19 to August 1 camp was established at the abandoned Hudson's Bay Post of Fort McKenzie (56°50'N, 68°58'W). This post is situated at the junction of Lac LeMoyne and the Swampy Bay River, the latter eventually draining into the Koksoak River and thence into southern Ungava Bay. During our stay, there was a pair of starlings (*Sturnus vulgaris vulgaris*) with at least five young ones living about the post. The young were fully fledged but were still being fed by the parent birds.

This is the most northerly breeding record for eastern Canada, southern James Bay and the north shore of the Gulf of St. Lawrence being the previous records. Climatically it is

at the northern border of the Open-Boreal Forest where the ground cover is mainly lichens. The only comparable western record is from Churchill, Manitoba.

Starlings are common at Seven Islands, on the north shore of the St. Lawrence River. From this town, there extends a series of railway construction camps northwards for 365 miles. The writer camped at Mile 134 and at the last camp, Burnt Creek, which has been an active little town for several years. However, no starlings were seen at either of these sites.

It is remarkable that this pair of starlings should have penetrated so far northwards and yet have missed the active railway camps, flying 130 miles farther north to settle at an abandoned Hudson's Bay Post. Whether they arrived by storm or through grim determination is mere speculation, the fact remains that this hardy and aggressive species has once more demonstrated its success in spreading over and colonizing the North American Continent. — SHERMAN BLEAKNEY, *National Museum of Canada, Ottawa, Ontario.*

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## REVIEWS

**A Review Of The Living Representatives Of The Genus *Alces*.** By Randolph L. Peterson. *Contributions of the Royal Ontario Museum of Zoology and Palaeontology*, No. 34, Toronto, 30 pp.

This review of the genus *Alces* is the most complete and thorough study of the group that has ever been undertaken particularly with regard to the North American moose, which has been sadly neglected by taxonomists. This is probably due to the fact that in order to examine an adequate series, the zoologist must visit a large number of scattered museums. This is, in fact, what Dr. Peterson did, and we are grateful to him for this valuable report.

No less than 304 specimens were used in the study, including seven skulls of Old World forms. It is evident, therefore, that the findings are based on adequate material. Although 44 separate cranial measurements were made in the course of the study, ten were chosen as most useful for taxonomic purposes. These are described and the results are tabulated. The three most significant characters in terms of subspecific variation are shown graphically.

After a careful study of the material and a comparison of Old and New World forms, the author concludes that the Eurasian elk and the North American moose are conspecific. Earlier authors have suggested that they should be so regarded, but none of them had sufficient evidence to substantiate his theory.

Seven subspecies of *Alces alces* are recognized: *alces*, *cameloides*, and *pfizenmayeri* from Northern Europe and Asia, and *gigas*, *shirasi*, *andersoni* and *americana* from North America. *A. a. gigas* occurs in Alaska, western Yukon and northwestern British Columbia, *shirasi* in the northwestern United States

north into southwestern Alberta and southeastern British Columbia, and *americana* from central Ontario east throughout the forested regions to the Atlantic provinces. *A. a. andersoni* occupies the area between *americana* on the east, and *shirasi* and *gigas* in the west.

Each subspecies is treated in considerable detail, particularly the North American races. The study reveals that, compared with other races, *americana* has the narrowest palate relative to the length of the toothrow and the occiput is low. At the other extreme, *gigas*, has a wide palate relative to the length of the toothrow and the occiput is high. *A. a. shirasi* is rather intermediate, but the toothrow averages shortest of all. As might be expected, *andersoni* is rather intermediate between *americana* and *gigas*, the palate is broader than in the former, but narrower than in the latter, and the occiput is low when compared with *gigas*, but higher than in *americana*. It would appear that there is a broad cline in this species in North America, extending from Nova Scotia west to Alaska.

The revision of any poorly understood group of animals is always a welcome addition to our knowledge. This is especially true of such an important genus as the one treated in this report.—AUSTIN W. CAMERON.

**Proceedings of the Xth International Ornithological Congress, Uppsala, June 1950.** Edited by Sven Hörstadius, General Secretary. Printed at Almqvist and Wiksell, Uppsala, 1951. Copies may be obtained from Professor Hörstadius, Zoologiska Institutionen, Uppsala, or from the printers, for 35 Swedish Crowns.

This handsome volume of the proceedings of the Congress, comprising 662 pages, was published with the aid of grants from Sweden,

Unesco, and the Smithsonian Institution, under the patronage of the International Union of Biological Sciences.

The presidential address by Alexander Wetmore on "Recent Additions to our Knowledge of Prehistoric Birds 1933-1949" is published in full, as are four synoptical surveys by Messrs. Drost, Lack, Mayr, and Tinbergen, and the "Introduction to Swedish Ornithology" by Sven Hörstadius. Other authors, because of limited space, have had to limit themselves to short reports and references to places of detailed publication.

There had not been a congress between 1938 and 1950 and consequently summaries showing advances in knowledge during that time assumed extra importance. R. E. Moreau (editor of *The Ibis*) looks at the whole question of migration with interesting results, such as the thought that migration was much older than the Pleistocene glaciations. The spectacular climatic fluctuations of that period occurred during less than the last one million years, a period less than one hundredth part of the age of the class Aves. Birds capable of long distance migration existed over thirty times as long ago as the first of the Pleistocene glaciations.

It is impossible to review this volume which touches on all fields of ornithology, with discussion usually by leaders in each.

To read this report gives some idea of the amazing experiences which await any ornithologist who attends one of these world gatherings. The effort put into arrangements

for meetings, excursions, banquets had to be experienced to be believed. Language difficulties were probably the most severe handicap, but even these were dealt with as when our scholarly secretary gave his address of welcome in eight different tongues!

Only four Canadians attended the Congress, but all interested can read about it in this book and thus keep up to date with ornithological studies elsewhere in the world. —HOYES LLOYD.

**Annual Report of the Province of Quebec Society for the Protection of Birds, Montreal, 1951.**

This Annual Report of one of our affiliated societies contains an extensive list of observations on birds made in 1951 including a summary of migratory movements. — H. A. SENN.

**Dawn Song and All Day, Volume 1, Number 6, February, 1952.** *Bird Research Station, Glanton, Northumberland, England, Price 1/6.*

Synchronized observations on the dawn and dusk chorus were made in 1951 on March 25, May 13, September 23 and November 18. On March 25 observations were concentrated for the most part in the British Isles but observers also went out in India, North Africa and the European mainland. On the other main date, November 18, observations were made in New Zealand, Australia, India, Africa British Isles and North and South America. — H. A. SENN.

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to

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Due to the present cost of production of the Canadian Field-Naturalist the Council of the Ottawa Field-Naturalists' Club has decided that beginning with Volume 67 the Canadian Field-Naturalist will be issued quarterly. If finances permit each volume will consist of four numbers of approximately 48 pages each. Bi-monthly publication may later be resumed should circumstances warrant.

EDITOR.

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Published by the  
OTTAWA FIELD-NATURALISTS' CLUB

Entered at the Post Office at Ottawa, Ont., as second class matter.

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# The Canadian Field-Naturalist

Vol. 67

OTTAWA, CANADA, APRIL-JUNE, 1953

No. 2

## NESTING LIFE AND BEHAVIOUR OF THE RED-EYED VIREO<sup>1</sup>

LOUISE DE KIRILINE LAWRENCE

*Rutherford, Ont.*

### INTRODUCTION

SINCE 1940 when I began seriously to study birdlife in this area, the Red-eyed Vireo *Vireo olivaceus* (Linnaeus), each summer stamped itself most conspicuously on the pages of my note-books and upon my mind. This was due, in part, to the ease with which its nests were usually found. With the Oven-bird, *Seiurus aurocapillus*, the Veery or Wilson's Thrush, *Hylocicla fuscescens*, and the Least Flycatcher, *Empidonax minimus*, this vireo was also one of the most common migrants nesting in the region.

Apart from these reasons, the bird has always attracted me by its elegance. It travels through the foliage with which its sober colouration blends so perfectly, sometimes slowly, sometimes swiftly, but always with that stream-lined precision that above all others is a vireo's trade-mark. In its song, even, be it monotonous to many by its often endless repetitions, I have found subtle variations and a full-toned beauty, entirely enchanting. The closer acquaintance, which an intensified study of the species in 1949 and 1950 afforded, has but strengthened and supported my earlier impressions.

The data herein presented are based mainly upon daily fieldwork, amounting to many hundred hours, and the study of 9 special pairs. These pairs are designated by a letter, A, B, C, and so on, in the order in which they settled in the study plot and two numerals denoting the year, for instance, Pair E-50. Nest E2-50 denotes the second nesting of this pair. It is to be regretted that the adult Red-eyed Vireo does not readily allow itself to be trapped for banding and that therefore the interpretation of the behaviour of birds so alike and passing most of their time aloft among the crowns of the trees cannot be either as simple or as constantly accurate as with banded birds. Since

I felt it was more important to observe the birds act with as little interference as possible, no banding was attempted at the nests with the exception of some nestlings. Only one adult male was caught by accident and banded. For the recognition of individuals and pairs especially in 1949 and 1950, I relied therefore on the careful, almost daily, search of the territories, censuses, and the studying of individual traits in song, plumage, or behaviour.

I am grateful to Dr. J. Van Tyne and to Dr. Harrison F. Lewis for their kindness in supplying me with literature from their own libraries and that of the Wilson Ornithological Club. The courtesy of Mr. Andrew Thomson, Controller of the Meteorological Division of the Department of Transport (Canada) enabled me to base the weather data of Table 1 on information from the official records. Further, I have received generous and valuable aid from Mrs. Amelia Laskey, Mrs. Margaret Morse Nice and Dr. and Mrs. J. M. Speirs, assistance with literature, data from their own files and experience, and helpful guidance throughout this study.

### THE LAND

This region is located in central Ontario, south of the Mattawa River and not far from its source at Talon Lake and about 20 miles north of the north-western corner of Algonquin Provincial Park. Both north and south of the river the country is in the ecotone between Temperate Deciduous Forest Biome, Association No. 9 (*Tsuga-Pinus*-northern hardwood ecotone) and Coniferous Forest Biome, Association No. 2 (*Picea-Abies* Association), (Kendeigh, 1948).

The study area was a strip of land containing 16 acres between the south and south-eastern shores of a small lake, Pimisi Bay, through which the river passes, and Highway 17. From a fairly level plateau in

<sup>1</sup> Received for publication February 29, 1952.

the west part, the land sloped east and southwards towards the lake. It was thickly wooded by second growth, now becoming mature, mixed evergreen and deciduous trees, some attaining heights of from 60 to 70 feet. The evergreens consisted mainly of white and red pines, *Pinus Strobus* and *P. resinosa*, white spruce, *Picea glauca*, balsam fir, *Abies balsamea*, and the broad-leaved trees of white birch, *Betula papyrifera*, and aspens, *Populus tremuloides* and *P. grandidentata*. The undergrowth included red and mountain maple shrubs, *Acer rubrum* and *A. spicatum*, juneberry, *Amelanchier* sp., alder, *Alnus incana*, willow, *Salix* spp., and the forest floor was covered with bracken, *Pteridium aquilinum*, wild sarsaparilla, *Aralia nudicaulis*, and *Aster* spp., to name the most common. Among the flowering plants were bunchberry, *Cornus canadensis*, wintergreen, *Gaultheria procumbens*, polygala, *Polygala paucifolia*, and twinflower, *Linnaea borealis*. With the exception of a small clearing around our house and a few natural trails, the woods have been left entirely untouched for the past 15 years.

In the region as a whole, the Red-eyed Vireo was found in the forest as well as in the more open country, in woodlots forming islands of trees amid the fields and in those stretching along rivers, lakes and roads. In the forest it liked southward and eastward slopes and it was also encountered in places near water or where rock formations, or fires, or the logger, had thinned out the tall timber, thus creating lighter areas in the pine-spruce forest. While the bird nested both in coniferous and deciduous trees and while the undergrowth of its habitat might be fairly well scattered, in situations where there was none or a low percent of deciduous trees and where the undergrowth was totally lacking, the Red-eyed Vireo was not present. This confirms Dr. Kendeigh's conclusion (1947: 56), that a certain proportion of broad-leaved trees is necessary for the occurrence of this species. Generally it may be said, that an overhead canopy of verdure, more or less continuous, under which to feed, sing and nest and above which it rarely ventured except of necessity (see Defence behaviour) appeared to be the chief requirement of this vireo. Yet, in years of particular abundance, I have found the Red-eye not uncommonly singing from the shade trees in the city of North Bay in the midst of summer, or nesting in isolated clumps of

bushes on the outskirts of settlements or in a pasture or field, where the green roof was less than 20 or 25 feet high and where there was not a single taller tree.

### ARRIVAL IN SPRING

In the middle of May when the trillium and the red cherry burst into bloom and the birch and the aspen are about to unfold their new leaves, the Red-eyed Vireo may be heard in these parts, announcing its arrival by a few clear and fluent song phrases. The bird is one of the later migrants, from 3 to 16 days later than the Solitary Vireo, *V. solitarius*, but generally a few days ahead of its other relative, the Philadelphia Vireo, *V. philadelphicus*.

In the past 11 years, the arrival dates have ranged from May 1 to 24, with a mean of May 16. The median date, however, was May 19 which is probably more representative for the Red-eyes of this region than May 16, since the last date is derived from data with a large spread and covering hardly enough years for an accurate estimate. Incidentally, May 16 is the Red-eyed Vireo's mean arrival date for the Toronto region, 240 miles south of Pimisi Bay, (Gunn and Crocker 1951: 143); but this average was established from the records of Mr. James L. Baillie over a period of 27 years, and hence computed from sufficient data upon which a representative mean date might be based.

Table 1 shows the dates of first arrivals and pertinent weather data. As will be seen, the maximum and, especially, the minimum temperatures of the day before and the days of first arrivals average higher than the Normal May Means, the maximum from 3.8 to 1.0 degrees and the minimum from 3.2 to 0.4 degrees F. In all the years but one, 1948, southwest winds and a flow of warm air into the region preceded these dates. The years 1941 and 1942 with the exceptionally early arrival dates featured April mean temperatures considerably above the Normal Means of the month and spells of unseasonably warm weather and SW winds occurred before and on these dates. The late arrival in 1948 was probably only of local significance, i. e. the birds due to pass through or to reside in or near this locality happened to miss the favourable periods of May 4-5 and 13-15 and instead became delayed by the cold weather May 17-22 when N and NW winds for the most part prevailed. The great storm of April 4-7, 1947, that in such a

TABLE 1. — First arrival dates of the Red-eyed Vireo in relation to temperature and weather

TEMPERATURES (degrees Fahrenheit)

Year	Date of arrival	Date of arrival		Date before arrival		April mean		May mean		Notes
		max.	min.	max.	min.	max.	min.	max.	min.	
Normal						48	28	62	40	
1940	May 22	68	56	70	40	42.8	23.8	61.0	40.1	Warm May 15, 21-23; otherwise May normal or below.
1941	May 7	64	53	66	44	53.7	31.9	63.8	41.1	May 1-8 max. aver. 61; cool May 9-13; SW winds May 6-7.
1942	May 1	82	53	75.1	39	53.0	32.1	61.8	42.1	Apr. 23-30 maximums above 70; winds SW Apr.28-May 4.
1943	May 20	71	38	62	37	38.2	20.8	60.9	40.6	May 20 warmest day; May 19-20 winds light variable.
1944	May 14	59	38	58	53	42.8	22.9	66.8	45.3	May 14 noon winds shifted SW; warm Apr. 29-May 4; normal or below May 4-14.
1945	May 21	64	45	64	38	49.1	31.9	56.2	36.9	May 19 warmest to date in May.
1946	May 17	63	34	46	39	46.7	28.8	56.9	37.9	May 14-15 winds light S; May 16-17 winds NE.
1947	May 20	55	39	74	48	41.0	23.3	54.4	36.7	May 18-19 very warm; winds shifted to strong N night of 19-20.
1948	May 24	56	37	50	31	51.5	29.6	59.4	37.5	Warm spells May 4-5 and 13-15; otherwise normal or below.
1949	May 16	71	39	61	30	48.1	27.6	61.3	38.7	Very warm May 1-6, cool 7-13; winds shifted to SW May 15 p.m., turned warm.
1950	May 19	71	43	67	45	39.1	22.2	61.7	39.7	Except May 5, normal or below till May 18, very warm to May 26.
Mean	May 16	65.8	43.2	63.0	40.4					
Median	May 19	64	39	64	39					

Note : Temperature above the Normal Mean in italics.

All weather data above the line by courtesy the Meteorological Division, Department of Transport, Dominion of Canada.

spectacular way affected the spring migration of some insectivorous birds in eastern North America, according to the analysis made by Gunn and Crocker (1951:148) had ceased influencing the movement of the birds on a line some 100 miles south of Pimisi Bay and, as could be expected, the Red-eyed Vireo's arrival here in that year was therefore about normal.

These data are in accordance with Nice's findings (1937:44-46) on the arrivals of the

first males of the Song Sparrow, *Melospiza melodia*, and of 8 other species; in all, the first arrivals were "absolutely dependent on a warm wave" during the preceding 10 days. In later studies on the relation between the weather and the movement of birds in spring, Bagg, *et al.*, (1950:13) said, that "during the period of spring migration, pronounced movement will take place into or through a given region during the interval between the passage of a warm front through that

region and the subsequent arrival of a cold front", but that this "may be less absolute in character during the later part of the spring migration than during the earlier part".

In this locality, no pronounced "main" migration of the Red-eyed Vireo was observed. It is possible that, having come so far north in their range, the birds have already dispersed, and this would preclude any larger concentrations. Only in a year when the weather held back the mass of the migrants until very late and warm weather suddenly released a major movement northwards, Red-eyed Vireos in somewhat greater numbers than usual have been seen.

The male Red-eyed Vireo arrives before the female. In 5 cases, the intervals between the arrivals of the male and the female of mated pairs on given territories varied from 3 to 15 days. In two instances occurring in the normal spring of 1949, the males arrived comparatively early and the females comparatively late, May 16 and 28, respectively, and May 18 and June 2. In that year, the intervals between the male and female arrival dates were 6 to 12 days longer than in the 3 other cases which took place in 1950. That spring the weather was unseasonably cold up to May 18, then changed abruptly to abnormally warm, and the heat-wave lasted until May 26 with temperatures ranging above 80° F. This, evidently, caused the arrivals of the females to telescope into those of the males, May 23 and 25, respectively, May 23 and 28, and May 23 and 28, the cold having retarded the males on the last leg of their journey and the heat-wave having speeded on the females.

With unmarked birds reliable data on the spread between the arrival dates of the males are difficult to obtain. While I am sure of the date of the first male, the last date may not be that of the latest arrived male whose existence was perhaps not discovered until after the beginning of the nesting. What information I have on the extreme arrival dates of the males in 1949, May 16 and June 11, and in 1950, May 22 and 24, suggests that, as with the mated pairs, the dates of the males spread over a longer period of time in the normal year 1949 than in the year following, when the weather caused a concentration in the arrivals of the birds concerned in both groups.

One male Red-eyed Vireo which was banded in 1948 returned the next spring.

But of 17 banded nestlings, none was seen again the next season.

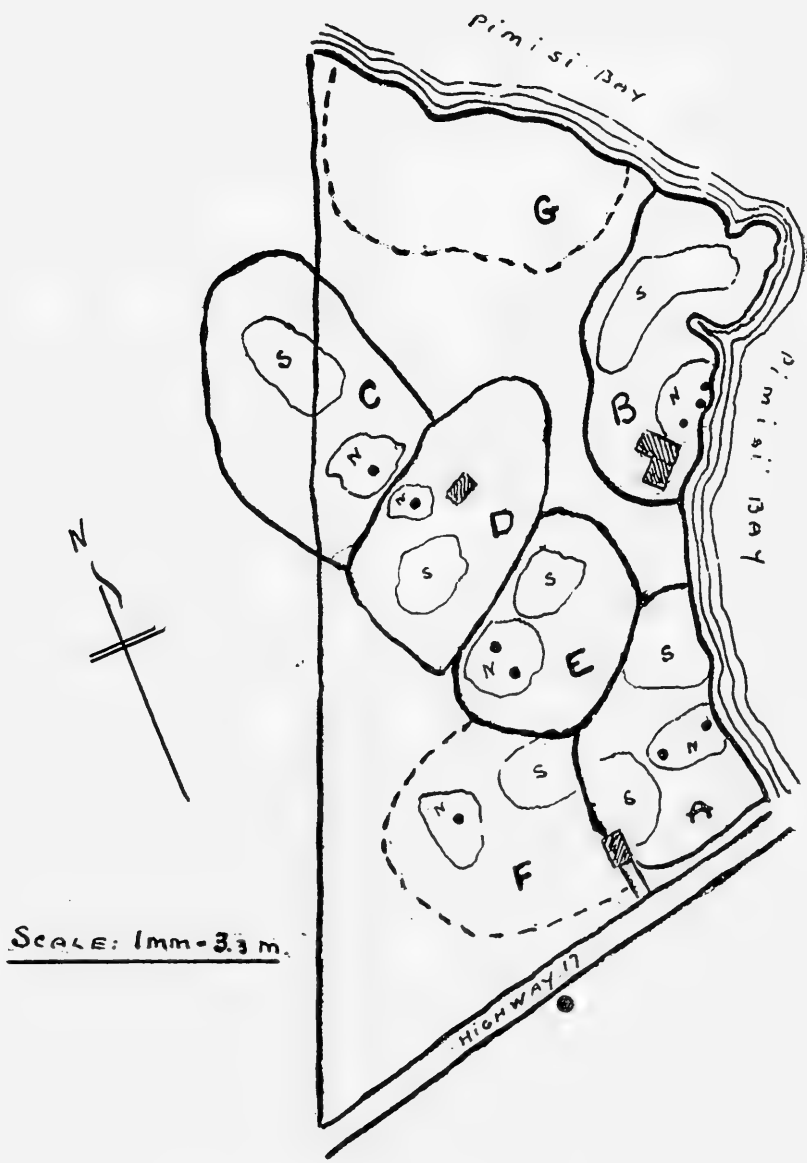
### THE TERRITORIES

Certain corners of the study area were occupied by Red-eyed Vireos as far back as I can remember and often old nests or their tattered remains were found hanging within a few feet of a new one. These preferred habitats were in the NE and SE parts of the plot and another stretched across the west line diagonally from the SE corner, see Map 1.

The NE corner is densely wooded rocky ground containing a moist cedar-grown ravine and a marshy spot between a small peninsula and the main land. The SE corner consists mainly of an alder-grown marshy spot created by the overflow of a spring which meanders down the wooded slope from the west. The W corner is an entirely dry plateau and slope. These corners have 3 features in common: dry SE slopes, one or two groups of very tall deciduous trees with large crowns, and one or more dense thickets of young trees or bushes. During years of denser occupancy, the vireo territories expanded westwards along the highway, northwest along the lakeshore, and across the plot from SE to W. In this way, all the parts of the area containing the 3 main features became utilized. From this it may be deduced, therefore, that in this locality the "key-aspects" (Miller 1942:25-35) of the Red-eye's territory are SE slopes, which are lighter and warmer, combined with tall trees singly or in groups, and thickets of young growth.

These requirements become further explained when we find that the Red-eye's territory is divided into two special areas. One of these I have called the "song area"; it consists of one or several tall broad-leaved trees with large crowns and belongs especially to the male. The other, the "nest area", contains the nest site and belongs especially to the female.

The map shows the territories in 1949. F and G belonged to two pairs whose nests I could not locate during the breeding season. Territory A had 2 "song areas", B had a rather extensive one, while in all the other four territories, C, D, E and F, the "song areas" were concentrated and well defined. All the nesting attempts of a given pair during one season were made within the "nest area". The uses of each "area" as well as of the territory as a whole will be further discussed later.



Map 1. Red-eyed Vireo territories in 1949.  
S=song area; N=nest area; ●=nest.

Seven pairs resided in the study area in 1949. The sizes of five of these territories were; A — 0.7 acres, B — 1.4 acres, C — 2.4 acres, D — 1.6 acres and E — 0.7 acres, or an average of 1.4 acres.

In 1950 only 4 pairs took up residence in the area. Pair A-50 took over B-49's territory almost to its exact previous limits, or 1.4 acres. The "song area" remained about the same, but the "nest area" was shifted

to another thicket in the NE corner. Pair B-50 took over half of A-49's and F-49's territories, or 2.3 acres. They used F-49's "song area" but shifted A-49's "nest area" slightly westward. Pair C-50 located in C-49's territory, including some of D-49's land as well, or 2.6 acres. Pair E-50 took in the whole of E-49's, part of D-49's, and the other half of A-49's territories and also a piece of neutral land, or 2.2 acres. They used E-49's

song and nest areas unchanged. The average size of the territories in 1950 was 2.1 acres, 0.7 acres more than in 1949.

In the Black Sturgeon Lake region, Dr. Kendeigh (1947:55) found  $3\frac{1}{2}$  Red-eyed Vireo territories within a 25-acre plot to average 1.9 acres, ranging from 1.5 to 2.1 acres.

### PRE-NESTING ACTIVITIES

Unlike its two other relatives, *V. solitarius* and *V. philadelphicus*, which as they move northwards through these woods punctuate their course by song after song, the transient Red-eye may sing, but seldom with the verve and clarity with which its later efforts are characterized. The resident bird, as it arrives, may reveal itself by a short session of song, but for a short while thereafter his singing is usually slow and desultory. At this time, only a wave of migrants may arouse him and make him conspicuously vocal while the flock passes through his treetops, singing, chasing and feeding. The arrival of a second vireo male to an adjacent territory is generally the trigger that sets off the vocality. But even then the volume of song may depend on how many newcomers arrive, how closely they settle, and whether the individual belongs to the category of persistent singers, (see Chapter on Voice).

There was a marked difference in the volume of the first singing in 1949 as compared to 1950. In 1949, 7 males took up territories in the study area in rapid succession of each other after the first colour-banded male arrived. All but two of them settled border to border. Territorial singing that spring soon became loud and persistent. In 1950, only 4 males took up residence in the same area, with only one border touching between B-50 and E-50. Singing in the pre-nesting period of that year was surprisingly spasmodic in a species that usually excels in its tireless vocal efforts.

In both years, singing increased more or less gradually after the initial comparative silence. The greatest volume of song was delivered from a little before sunrise into the forenoon. In general, the song-phrases continued to be rather slow in tempo and sometimes disconnected, even though loud and at times of great clarity and beauty. The songs of 5 males, clocked between the day of arrival and June 1, averaged 29 songs per minute (s.p.m.), ranging from 20 to 42, as compared to the singing of the same males during incubation averaging 39 s.p.m., and

with the young in the nest up to the beginning of the post-nuptial moult averaging 50 s.p.m.

In my experience, the Red-eyed Vireo's vocal contributions were not so often given while the bird perched in one place and the use of preferred song-posts, which is common with many other species, does not appear to be a habit of this vireo. Most often he delivered his songs as he hopped along a branch looking for food, or as he mounted by stages through the foliage into the crowns of the trees, or anon as he descended to investigate the chance trespasser with an inquiring ruby eye. He sang between mouthfuls, before and after short periods of preening, and at times the speed of his delivery depended wholly upon the degree of his preoccupation.

The rest of the time he roamed, except perhaps when the weather was cold and he stayed hidden in shelter, quite silent. This roaming of the male as a preliminary to territory establishment I also observed in a Myrtle Warbler, *Dendroica coronata*, in both cases following marked individuals. The Red-eyed male was caught at this early stage after he flew against a window, at least 200 feet beyond the later established limit of his territory. The Myrtle Warbler was found singing one spring at literally the four corners of the 16-acre plot until, in competition with 4 other males of his kind, his territory finally became constricted to the center. By this roaming the birds "feel out" the resistance of other males of their own species and within the line which they cannot cross unchallenged, their territories eventually become established. Since both the Red-eyed Vireo and the Myrtle Warbler belong to the category of birds that require what Nice (1941:457) defined as Type A Territory, i. e. a mating, nesting, and feeding ground for the young all in one, the roaming is obviously a significant part of the pre-nesting behaviour. It is the means by which the largest practicable amount of living-space is acquired.

As may be expected, the arrival of the female considerably changed the pre-nesting picture. The male stopped singing, (see Nice 1937:43), to start anew as the search for the nesting site got under way. The larger area with the flexible boundaries through which the male had roamed hitherto acquired definite lines as the female indicated her preferred nesting area. Now, with the female in the lead, the birds moved through their domain, the male having become her attentive

escort. The scolding note, this peculiarly peevish "meeyaæn, meeyaæn" uttered with open bill and a nasal twang and not heard before, began to be used commonly, because now the situation had changed, involving a center point that must be kept inviolate.

Only once I witnessed the actual introduction of a female to an unmated male. Whether this way was typical is therefore not possible to demonstrate. But in 1948 I saw a similar procedure of "segregating" a female out of a flock of passing migrants by the colour-banded Myrtle Warbler. On this occasion the interpretation of the event was facilitated by the dimorphism of the warblers and marking of the male, and this experience helped me to understand the vireo behaviour.

Male E-50 was singing in his song area, a tall poplar, as a flock of migrants including another Red-eye came through his territory. All of a sudden, he ceased singing and dove down from aloft. He began the most spectacular pursuit of the other bird I have seen among vireos, round about, in loops, in circles through the underbrush. Finally, by sheer force and passion, he bore the other to the ground. The whole action took place in utter silence until the very end, when I heard the mating note "aërrrrrr" given once. From this moment there were two vireos in Territory E-50.

Shortly after arrival, the female began examining the forks of bushes and branches as prospective nesting sites. She did this rather casually at first, as if the nesting urge were not yet fully awakened within her. She might interrupt her feeding, hop along a branch sideways to a likely fork. This she inspected closely from above, from all sides, and from below.

With crown and throat feathers on end the male attended her. He approached with wings a-quivering and either he or she gave the mating note, "aërrrrrr". In the event she did not object to his propinquity, he flipped down his tail at right angles to his body and spread it out like a fan. Sometimes at such a moment I heard a mellow continuous warbled song, containing exquisite variations of the vireo themes. At this, the female might also display with trembling wings if she were in a receptive mood, and with tail raised she would crouch and invite the male to coitus with a softly uttered "quot-quot-quot". Copulation was a brief and airy affair performed with strongly vibrating wings and sometimes an excited twittering.

As in the Song Sparrow, (Nice 1937:84), copulation in the Red-eyed Vireo also began shortly before nest-building. But at this time the females I followed appeared far less receptive to amorous advances than they became later in the period between the completion of the nest and the egg-laying. A female quite often would rebuff a male at this stage, simply by side-stepping him or if he were too persistent by gaping and biting at him. The mating ritual varied individually, often some of it was omitted in the rapid approach of a male at an auspicious moment.

In discussing courtship-feeding in birds Lack (1940:177) said: "Vireonidae (vireos). Not recorded." To my knowledge, there is no mention of this behaviour among vireos in the literature until Kendeigh (1947:56) recorded an instance at Black Sturgeon Lake when a male fed his begging mate during nest-building. In this study, as will be shown, courtship-feeding was found to be an important part of the behaviour of the Red-eyed Vireo. During the pre-nesting epoch, however, it appeared of rare occurrence. I saw it but once or twice, or else I missed it with the birds often hidden amongst the foliage high in the treetops.

The male was more aggressive than the female during the prenesting period. Before the nest area was established, the territory, which is a male concern, had to be watched and guarded. Nevertheless, the male Red-eyed Vireo did not impress me as being a typically aggressive bird. Rather, pugnaciousness was a quality introduced with the settling of the site of the nest. Individuality played a role, as it did in all the behaviour of this vireo. The territorial disputes I saw were conducted either by fast pursuit flights or by stalking through the foliage, from level to level, from twig to twig. Sutton (1949: 20) wrote: "According to Hamerstrom's field notes, territorial disputes amongst Red-eyed Vireos were almost incessant in the Big woods on May 20, 21, 1946." But the type of behaviour was not described.

One morning Female B-50 was seen feeding in a treetop. Another Red-eye was not far from her while the owner of the territory, Male B-50, was singing in a tree to the left. The strange bird, presumably a male, tried to approach the female. She hopped away from him and as he came closer she turned upon him in a half crouching position with bill gaping. At this moment, MB-50 darted headlong at the intruder and chased him. All



three birds flew into another treetop where they hopped from branch to branch, the pair stalking the outsider in complete silence, warily, "deliberately" watching his every move. This went on for several minutes from treetop to treetop. Presently, without any other move of hostility, the crisis dissolved as the stranger flew away. Then MB-50 gave several very loud songs.

The female usually needed 5 to 6 days to complete her choice of nest site. In second attempts she required less time, 3 to 4 days. In the third nesting of Pair B-49 the second nest was abandoned after 9 a.m. one day and the construction of the next was well under way by 10 a.m. the following morning.

In the afternoon, the day before she actually started to build her nest, one female was seen returning again and again to the fork in a low hazelbush that she fancied most. Finally she alighted on the trunk of a white birch and pulled off a small strip of tissue-thin bark. With this she flew to her favoured spot. She laid the strip carefully over one arm of the fork, where its papery ends floated and twirled in the breeze, like a tiny white signal flag.

THE NESTS

Forty-four nests were found in the study area as follows:

White birch	11
Hazel bush	6
Red maple bush	6
Trembling aspen	5
Mountain maple bush	2
Large-toothed aspen	1
Juneberry	1
Willow	1
Dogwood	1
Total in deciduous trees	34 (77%)
White cedar	5
Balsam fir	4
Red pine	1
Total in conifers	10 (23%)

Other trees in which the Red-eyed Vireo's nests have also been found include bur-oak, hackberry, (Nice 1950:1-4), beech, (Common 1934:241), chestnut, (Herrick 1935:225), elm, (Stephens 1917:25), basswood, sugar-maple, (Kendeigh 1945:418-436), white oak, hickory and witch hazel, (Sutton 1949:21-23). In the northern range, nests in conifers have also been reported by Doris Speirs (in litt.) who found 4 at Lake Opeongo, Algonquin Provincial Park, Ontario, on June 28, 1947, and Kendeigh (1947:56) observed a bird building its nest in a balsam fir at Black Sturgeon Lake, Ontario.

The height of the nests varied from 3 to an estimated 55 feet. Sutton (1949:22) believed that "the Red-eyed Vireo nests high more frequently than has been supposed". If the 44 nests in question were divided into two groups, one of low nests at elevations up to 15 feet and the other of high ones at 15 feet and over, we find that 32, or 73 percent, were low nests and 12, or 27 percent, were high.

The high nests are, of course, much harder to find than the low ones and it is also harder to find nests of second and third nestings amongst the lush foliage of midsummer, particularly as they also have a tendency to be at higher elevations. Taking the nests found in the years 1945-1949 as an example, we have a total of 26 nests of which 19 were first nestings, representing at least 95 percent of all possible nests, and 7 were of second nestings, approximately 50 percent of all possible nests. Assuming that 7 other nests of second nestings, presupposed from the record of the nesting success, were all high, we get a total of 14 high nests. In other words, about 42 percent of all nests built in the area during these five years would be higher than 15 feet from the ground. This is probably a rather high figure.

The tendency toward higher elevations in second nestings is shown in Table 2. This, however, was a rule with many exceptions.

TABLE 2. — Height of the nests of the Red-eyed Vireo

	Low nests			High nests		Av. height feet	Range feet
	No	No	%	No.	%		
1st nestings .....	26	23	88	3	12	9.5	3 — 55
2nd nestings .....	17	9	53	8	47	14.9	3½—35
3rd nestings .....	1	—	—	1	100	50.0	— —
All nests .....	44	32	73	12	27	12.5	3 — 55

Pair B-49 nested 3 times at heights of 8, 20 and 50' (est.) feet, respectively; Pair E-49 nested twice at 5 and 30 feet and Pair E-50, probably the same birds, also twice at 5½ and 8½ feet; one pair in 1945 nested twice at 8 and 15 feet in the same tree; but FA-49 nested first at 18 and then at 10 feet and a pair in 1948 built two nests in hazelbushes at exactly the same height, 3½ feet; Pair B-50 built their first nest in the top of a white birch an estimated 55 feet from the ground. Sutton (1949:22) recorded a nest between 40 and 45 feet, which obviously also was a first nesting since it was found on June 4.

In some other species there seems to be the same tendency towards higher nests in later nestings. Walkinshaw (1945:9) found that the nests of the Field Sparrow, *Spizella pusilla*, became progressively higher and Nice (1937:92-93) found 9/10 first nests of the Song Sparrow on the ground but only ¼ of third nestings.

The situation of the nesting tree varied greatly and nests were found at the edge of clearings, a little away from the edges, in thickets, near the lakeshore or over the water, and so on. One prerequisite was indispensable, a density of foliage either beside or above the nest site through which the birds could approach inconspicuously. Although the Red-eye rarely left the nest through this "protective area", I never saw it approach by any other avenue.

Sutton (1949:18) suggested that "a contiguous feeding area, either surrounding it (the nest) or immediately to one side, is a necessity", and he considered this especially important for the young as they leave the nest. In my experience, the birds seldom fed in the close vicinity of the nest under ordinary circumstances but in quite another part of the territory, and after leaving the nest the young amazingly quickly betook themselves out of the nest area.

The nests were generally skilfully camouflaged among green leaves or the needles of conifers. In some instances I found a tendency towards building whiter nests in light places and darker ones in shaded conifers. One nest, exposed to much sunshine in a white birch, was made extensively with bits of white tissue paper, but another deep in the shade of a white cedar included quantities of strips of brown inner bark and fuzzed brown wool. Green leaves were often interwoven into the sides of the nestcup. Nest B1-49 was festooned with the leaves of the white cedar in which it hung and the third nest of the same pair with cascades of green aspen leaves.

The nestcups were suspended in two different ways, either from a fork (one angle suspension) or between two twigs and the nesting branch (two angle suspension). Since the incubating or brooding bird must face a main point of suspension or else be uncomfortably pitched forward over a more or less sagging unanchored side, it had no choice of position in the one-angle nests, while in the two-angle nests it could and did face two directions alternatively. Needless to say, the two-angle nests were better in other ways also; in them the unanchored side was shorter and less susceptible to sagging. Both kinds were built by the same female.

Measurements of 4 nests are given in Table 3.

On the outside, the Red-eyed Vireo's nests are made of fine flakes of white birch bark, paper of wasp nests and spider silk. Strips of the inner bark of cedar and aspen, which are picked off dry trunks or sticks amid fluttering and airy gestures, are used for the inner walls. The lining is made of dead pine needles, grasses, strands of bindweed and sometimes a few hairs of the varying hare or the white-tailed deer. The spider silk is of utmost importance in the Red-eye's construction work. It is elastic and adhesive

Table 3. Measurements of 4 nests.

	Inside diameter	Inside depth	Outside diameter	Outside depth
Nest B1-49	51 x 62 mm.	50 mm.	60 x 75 mm.	68 mm.
Nest C-49	47 x 63 mm.	40 mm.	70 x 73 mm.	70 mm.
Nest D-49	52 x 62 mm.	37 mm.	75 x 83 mm.	70 mm.
Nest E-49	55 x 63 mm.	41 mm.	85 x 87 mm.	76 mm.

Nests B1-49 and C-49 were two-angle nests.

and is used extensively to hold the materials together, to attach the nest to the fork or forks, to finish the edges, for repair work and generally, to give the nest its "licked-over" appearance. Its main source of supply is from the underside of the leaves of ferns, especially bracken, and bush honey suckle, *Lonicera* sp.

The durability of this pensile masterpiece was remarkable. Nests survived the weather from one to two years. In this respect it ranked third in the Pimisi Bay region after the nests of the Rose-breasted Grosbeak, *Pheucticus ludovicianus*, and the Baltimore Oriole, *Icterus galbula*. In my experience the Red-eye never used a nest twice.

### THE BUILDING OF THE NEST

The earliest nest observed in the Pimisi Bay area was begun on May 28 and the latest on July 15.

The time required for so elaborate a piece of work was comparatively short; normally it took from 4 to 5 days. For a nest watched continuously during the time it was being built, F. H. Herrick (1935:225-237) gave the time as  $4\frac{1}{2}$  days.

Surprisingly soon after the start, the nest acquired shape and form and generally at the end of the first day, if the weather was favourable, the cup held the bird even as she began the first moulding. But the next stage, the interminable polishing of the outside, the shaping and the starching of the edges by means of applications of spider silk, and the lining of the inside, took the longest time.

Even though the work seemed finished and the nest hung there apparently fully completed, the bird often prolonged the final touches far into the nesting cycle. In the period before the egg-laying began, during incubation, and even when the nest was full of young, new adhesive material was brought time and again, the outside was polished or redecorated and the edges attended to anew. FC-45 was seen in a session of energetic nest fixing on the 9th day of incubation; in the course of 10 minutes she was off and on 8 times, fetching fresh spider silk, attaching it to the outside and then drawing it over the edges in long elastic threads, or she festooned it in lacy fringes all over the outside. FB-49, during the third nesting, brought fresh spider silk on August 5 for the last time, when the young were 3 days old. I believe that the tendency to excessive nest-fixing in these two females was caused by nervous tension,

in the first bird owing to a restless disposition in general and in the second because of an overly extended nesting season.

Nest A2-49 was watched for an hour and 20 minutes in the morning when it was half completed. The female did all the work, but the male attended her closely. At intervals he gave slow, loud, clear songs. With the female a little ahead of the male, the pair came and went with speed and dispatch, as if by a set schedule which must be followed at all costs and no time lost on distractions. Once the male inspected the nest while the female worked, but most of the time he kept at a distance. At another time she flew to him and he fed her. She brought her nesting materials at average intervals of 3.2 minutes and remained working for periods averaging 20 seconds, ranging from 4 to 70 seconds. This nest was 10 feet 2 inches from the ground in a white cedar.

Nest B1-50 was observed a total of 2 hrs. and 5 min. on the 2nd, 3rd and 4th days of building. It was in the top of a white birch at an estimated height of 55 feet.

This female also worked without help from the male. He sang quite frequently as he accompanied his mate to and fro, always perhaps a yard behind her. Sometimes he sat aside and watched her working. On six occasions he attempted to approach the female, courting her, his throat and head feathers on end, singing his mellifluous courting song and suggesting himself to her by the mating note "aërrrrr", or by an inviting "tetetewtew". On each occasion she repulsed him, twice by chasing him and once by crouching, trembling her wings and gaping at him, then darting away. Once on the second day while the female was absent, the male sat in the nest  $1\frac{1}{2}$  minutes, looking around. When he got off he hopped along the branch and burst into song.

Close by a Myrtle Warbler female was building her nest in the top of a balsam fir. She persisted in stealing materials from the vireos' nest. Several times she was caught in the act by FB-50 from an ambush and forcefully chased with loudly clattering mandibles. The male took no part in this defence of the nest.

On account of this intermezzo and also because the weather was showery, the work on this nest was carried out in fits and starts. Long intervals of idleness alternated with periods of frenzied zeal, during which the female brought loads of material every 4

minutes on an average, ranging from 1 to 8 minutes. Nevertheless, this nest was completed in 4½ days on schedule and it was a neat creation.

The building technique consists of 3 main parts: the preliminary suspension attachment; the formation of the main nest body by piling loose material across the arms of the fork or forks and gluing it to the suspension frame; the inside moulding and trampling, the lining, and the outside starching, smoothing and polishing.

The female stands on the apex of the fork and works outwards. She glues her materials to the arms of the fork with spider silk, out of which she draws long threads and sweeps them around the twig, including any other twigs, stems or leaves that may be encountered. A nest at this stage looks like a fringed triangle without a base. When working the loose material, she leans forward and downward, glues all of it together into a mass and attaches it to the frame with spider silk. As soon as it has acquired enough starching to hold together, she begins moulding and trampling the nest mass, which in time leads to blocking the nest neatly into shape. The unanchored side and the bottom remain open until the last. In many nests the loose material is left trailing at the bottom like a curly tassel, but in others every thread is caught up and tucked away and the nest has the perfect form of a small rounded basket.

In his account, "Building the Vireo's penile nest", Herrick (1935:225-233) gave a classic description of the way a Red-eye builds its nest. Minna A. Common (1934:241-242) told of a male which assisted his mate in the building.

### THE EGG-LAYING

In 7 first nestings, the interval between the completion of the nest and the laying of the first egg lasted from 2 to 4 days and in 3 second attempts one day. In the third attempt of Pair B-49, the nest was completed on July 18 and incubation started on July 20.

This interval might be called the birds' "honeymoon", a short time of rest and play between two important phases of the nesting cycle. During these days many species appear to detach themselves from the nest environment, sometimes to the point of leading the observer to believe they have abandoned it.

But to the Red-eyed Vireo the nest hanging there fresh and new continues to be the pivot around which the birds' activities and movements center. To and from the nest they dash through the foliage, the female leading one "pace" ahead of the male, as if their destination were a matter of life and death. Sometimes she brings another straw, another pine-needle or piece of spider silk, to add to the already completed structure. Sometimes she lets herself down into the nest to mould it yet another time, or merely to get the feel of it, one may suppose. At other times, the birds stop at a distance only to cast an eye upon their creation. To the female at least, the vicinity and the sight of the nest seem to create within her, step by step, the strong bond that must attach her to the site for the fulfilment of her reproductive role. Nice (1943:215), quoting Roberts, spoke of the nest site as "an area of great emotional valency."

At this time, the female often becomes conspicuous in her courting of the male. This generally happens within sight of the nest. She quivers her wings, spreads her tail fan-wise and flips it down stiffly behind her, crouches and utters begging notes. In most cases the male accommodates, but not always, as occurred in two pairs which I followed closely.

Often long after the male has flown, the female remains in an attitude of unsatisfied eagerness, wings still a-tremble, gazing after him. The next instant she, too, is gone only to return perhaps 3 times in 15 minutes, each time duly convoyed by her partner. He may be silent or else singing loud, clear, slow songs when near the nest, songs with a special meaning evidently and quite different from the fast performances he usually delivers from the song area.

As a rule, the eggs were deposited one a day early in the morning, before 7 or 8 a.m. Standard Time. In the first nesting attempt of Pair B-49, however, the last 2 eggs were laid later in the day.

Of 19 first nestings, 7 nests contained full sets of 4 eggs and 12 nests 3 eggs, and of 9 second attempts one nest contained 4 eggs and the rest sets of 3 eggs. The average set per nest was 3.3 eggs. According to Bent (1950:337), the most common number of eggs in the clutch of the Red-eyed Vireo is 4, of the Solitary Vireo also 4 (p. 294), and of the Philadelphia Vireo 4 (p. 353).

In the life-history of the tropical Yellow-green Vireo, *V. flavoviridis flavoviridis*, contributed by Skutch (Bent 1950:321-334), which bird according to this source appears to have much in common with the Red-eyed Vireo, it is said that 3 eggs is the usual set.

In two cases, where apparently the same females laid both sets of eggs at repeated nestings, the first set contained 4 eggs and the second 3. The single set of 4 eggs of the second nesting attempts was laid by FA-49 after her first nest had been broken up because of the disappearance of her colour-banded mate. I have little reason to doubt that this female was not the same bird in both nestings and, in such a case, she abandoned her first nest either during the laying or immediately after the completion of the set; the nest was too high to make sure. Nice (1937: 109) believed that an unusually large set of 6 eggs laid by one of her Song Sparrows at a later nesting was "a combination of the second and third sets." In the Lapwing, *Vanellus vanellus*, Klomp (1951: 176) found that the reaction to the removal of eggs during laying varied in accordance to the number taken, and that when the first egg is taken after being laid the bird produces another normal clutch of 4 eggs, or "the 2nd, 3rd, and 4th egg plus 1 additional."

Replacement of sets in relation to the time at which the first set was lost in my vireos did not coincide with Stresemann's findings, quoted by Nice (1937: 111), that in some birds a set destroyed soon after laying is sooner replaced than one which has been incubated longer or where the young have hatched. Data from 4 cases follows: 1) first nesting, set destroyed during or just after laying, replacement began 7 days later; 2) first nesting, after 7 days' incubation, replacement 6 days later; 3) first nesting, after young hatched, replacement 9 days later; 4) second nesting, after young hatched, replacement approximately 4 days later. In the Song Sparrow, (Nice same ref.) replacement always took place 5 days later with only one exception, and in the Lapwing (Klomp 1951: 177) it occurred within an average of 12 days in the cases of first clutches destroyed upon completion. My data, therefore, would only suggest that the contraction of other stages of the nesting cycle apparent in later nestings would also hold true in the replacement of lost sets of eggs.

## INCUBATION

Many observers, including Sutton (1949: 5), Saunders (1938: 106), F. L. Burns (Forbush 1929: 180), and others, have stated that in the Red-eyed Vireo both sexes incubate, but in no case did these authors present evidence to support this view. As I began this study, however, I soon found that this information was not in agreement with my observations, a circumstance which obviously required an especially careful investigation. On the basis thereof, I present my evidence that in the Pimisi Bay region the female Red-eyed Vireo was always found to incubate alone with no assistance from the male.

During more than 100 hours spent in watching the nests of 9 pairs, I was at no time in doubt of the whereabouts of the male, either because he was in sight and his identity known or he was singing elsewhere, while another bird, that could be none else but the female, was on the nest. No shifts were observed at any time at or near the nest, which sometimes occur in species where both sexes incubate. The incubating bird was never heard singing on the nest and I have no evidence at all that the female Red-eyed Vireo sings. When high nests were watched, the broodpatch of one bird was plainly visible as a pronounced division of the feathers, while in the other the division between the ventral feather tracts showed distinctly less, if at all. This was particularly obvious at Pair B-49's third nesting. As will be shown, the general behaviour of the birds during incubation followed two definite lines of male and female activities. Lastly, the incubation rhythm of the Red-eyed Vireo, see Table 5, followed closely those of other passerines in which only one of the pair incubates.

Nice found the female Red-eyed Vireo alone incubating at a nest in Jackson Park (1950: 2), and in 1949 she wrote to me: "I've never known of a dependable instance of the male Red-eye incubating..." Kathryn Ann Graves said in the abstract of a paper which she was to have given at the 67th Stated Meeting of the A.O.U., October 1949: "My conclusion that incubation is performed by the female Red-eyed Vireo alone is based on three lines of evidence: 1) the behaviour patterns of the adult birds at six nests during the incubation period; 2) observations of a pair the sexes of which could be distinguished with absolute certainty owing to the dis-

tinct marking of the female's feathers with black indelible ink; 3) analysis of the incubation rhythms of the females on four nests, and a comparison of these rhythms with those of 23 other passerine birds." Skutch (Bent 1950: 325) found that in the Yellow-green Vireo the female also incubated alone without help from the male.

Incubation began after the third egg was laid in all the nests found with sets of either 3 or 4 eggs. Before that, the female was seldom found on the nest except in the morning when she generally laid her new egg.

Nest A2-49 was watched during the first day of incubation for 3½ hours, beginning at 7.30 a.m. soon after the third egg of a set of four was laid. The female was attentive only 50% of the time. Her periods on the nest ranged from 8 to 26 minutes and her periods off from 7 to 38 minutes. Because of the incomplete set and the irregular rhythm, this observation is omitted from Table 7.

The behaviour of the male was also at variance from that which becomes characteristic later. He was more attentive to the female, even to the point of feeding her while she sat on the nest. None of the males watched in this study were seen close to the nests once incubation got well under way. MA-49 sang only 28 percent of the time and by comparison with later efforts (see Table 4) his singing was slow and spasmodic. Obviously the birds were in a stage of transition from one behaviour pattern to another.

When the female finally settled down to incubating in earnest, the male withdrew almost entirely to the song area where he spent much of his time alone, singing and feeding. It is here, during incubation and with the young in the nest, that the male Red-eyed Vireos' singing becomes such a

tireless performance. Some data of the males' singing during incubation are given in Table 4. There was considerable variation in the singing of individual males, but this will be further discussed under "Voice".

The female, meanwhile, usually sat very still on the nest. Once in a while she arose and turned the eggs, using both her bill and her feet. Then she adjusted herself comfortably on the nest again. At times she gave the nest another polishing, drawing loosened spider silk in over the edges. But most of the time she sat deep down with only her head and tail showing above the rim, motionless like a carved figure, and as the branch swayed gently her red eye once in a while caught the glint of a sunbeam. It was clear that all the time she was aware of the male's presence in the song area, even as I was. His leisurely singing there and her quietude on the nest beyond doubt were related phenomena and, certainly, the song was the paramount means of preserving contact between these two during the female's periods of attention.

Then the male stopped singing. Perhaps a minute later he appeared in the wings of the nest area, either giving slow, loud signal songs or else calling to his mate with the rolling raspy note "aerrrr". Usually the female heeded the cessation of the male's singing at once and she began fidgeting on the nest even before he approached. She raised herself, sank down again, turned her head hither and yon, peeped over the rim, as if torn between a desire to leave and to remain. Sometimes she gave the "aerrrr"-note as she espied her mate in the offing, and then bethought herself yet another minute. Then all of a sudden, in a perfect swan-dive, she was over the rim, making a direct bee-line to where the male was. In my presence, the female came off the nest only once in 7 times without inducement from the male.

TABLE 4. — Males singing during incubation

	Date	Day of incubation	Ob. time minutes	% of time male sang	Song phrases per min.
Male A2-49 .....	June 23	6th	180	74	21
Male C-49 .....	" 17	3rd	210	58	52-37-45
" " .....	" 22	8th	240	63	47
" " .....	" 27	13th	180	51	—
Male D-49 .....	" 24	12th	240	27	48

**TABLE 5. — The rhythm of incubation of the Red-eyed Vireo. Five females at six nests.**

Attentiveness												Average
				Ob. time	Temp.	On	Av.	Off	av.	atten-		
Date Day				minutes	degrees F.	Eggs	%	min.	Range	min.	Range	tiveness
Nest C-45	Jun 28	4th	165	68-74	3	69	23.0	5-44	7.3	6-9		
	Jul 1	7th	60	65-70	3	58	15.5	11-20	10.0	7-13		
	Jul 3	9th	107	70-75	3	71	7.3	1-30	3.4	1-9		
	Jul 4	10th	85	75	3	84	26.0	22-30	4.7	2-6	71%	
Nest A2-49	Jun 23	6th	180	70	4	77	32.5	21-40	8.2	6-10	77%	
Nest B1-49	Jun 20	5th	105	75	4	87	58.0	58	7.0	6-8		
	Jun 21	6th	210	75	4	81	32.3	29-36	9.0	6-11	83%	
Nest B3-49	Jul 23	4th	255	70-75	2?	83	34.2	22-52	7.2	6-10		
	Jul 29	10th	240	84-89	2?	66	13.6	1-57	8.0	3-13		
	Aug 1	13th	195	73-77	2?	88	36.0	27-45	8.0	7-9	79%	
Nest C-49	Jun 17	3rd	210	80	3	74	36.3	29-45	13.5	11-16	80%	
	Jun 22	8th	240	75	3	77	34.7	17-55	13.8	8-19		
	Jun 27	13th	180	78-80	3	68	27.0	17-32	16.7	12-26	71%	
Nest D-49	Jun 24	12th	240	60-64	3	76	34.0	21-45	11.6	7-16	76%	

As the pair met, the female displayed with her wings quivering. She flipped down her tail and spread it like a fan, she gave the begging note, a monosyllabic soft "tchet-tchet-tchet". With throat ruffled and crest erect, the male danced attendance upon her, fussing about her but not actually courting her. Now with the male in the lead, the birds betook themselves through the song area and adjacent parts of the territory. Often the female perched on a twig while the male foraged, by turns to beg and to peck a little by herself, to preen, and to beg again. Time upon time the male brought food and fed it to her.

Finally, usually at the end of 7 or 10 minutes, the female edged nest-wards. Often the male accompanied her to the "protective area", seldom far into it. There he left her. She went on alone, pecking a mite here and there, or preening a little again, and then if not disturbed she slipped through the "back door" and on to the nest. Away in the song area, the male once more commenced to sing, letting phrase follow upon phrase of reposeful melodies.

This consensus of activities is drawn from observations covering the years. But I would once more emphasize the Red-eyed Vireo's leaning toward individualism. This together with other factors, such as density

of population in different years, weather conditions, etc., sometimes cause certain modifications of rituals and behaviour, with new aspects being added at times and others left out.

The average attentiveness of 5 females at 6 nests was during the time of observation 76 percent. According to Nice (1943: 221, 227) the percentage of time spent on the nest by 9 passerines where only the females incubate ranges from 64 to 84.

As will be seen in Table 5, the rhythm of Female C-45 presents a rather irregular picture. She was a nervous and fidgety bird given to frequent sessions of nest-fixing, and the 4 short watches during which she was observed were not enough to smooth out her averages. In considering the 4 other females, however, we find that the attentive periods of 3 of them, A-49 (4 periods), C-49 (9 periods), and D-49 (4 periods), average from 32.5 to 34.0 min. Their off-periods show a greater divergence, A-49's 5 periods averaged 8.2 min., C-49's 11 periods 14.5 min., and D-49's 5 periods 11.6 min.

The 4th female, FB-49, was watched while incubating at 2 nests. At her first nesting, 4 attentive periods averaged 37.2 min., but at her third nesting 16 periods on the nest averaged only 22.8 min. This drop in averages was caused, in part, by higher



temperatures during the third nesting and a certain nervous tension in the bird that developed with the prolonged breeding season. But this was somewhat compensated by a shortening of the periods off the nest, 6 periods in the first nesting averaged 8.3 min. and 19 in the third nesting 7.8 min. This is also reflected in the average percent attentiveness (see Table 5) of this female. Her averages for both nestings were 26.2 min. for 21 periods on, and 7.9 min. for 25 periods off the nest.

The combined 53 attentive periods of the 5 females ranged from 1 to 58 min. with an average of 25.3 min. and a *median* of 29 min.; the favourite period on the nest was 32 min. Their combined 63 periods off the nest ranged from 1 to 26 min. with an average of 8.7 min. and a *median* of 8 min.; the favourite period off the nest was 6 min., followed by 7, then 9 min. These data become particularly interesting when compared with Nice's study of the incubation rhythm of 10 other passerines (1943: 221). She obtained a median for attentive periods of 29.8 min. and for inattentive periods of 8.5 min. "It seems," she wrote, "as if 8 minutes was a favourite period for small passerines to stay off the nest."

Some of my vireo females occasionally incubated for exceedingly long periods. FB-49's longest occurred on the 13th day and lasted 70 minutes when I had to leave her still sitting. FB-45, (not shown in the Table), furnished the record after which she unfortunately disappeared. She was sitting on the nest at 2.50 p.m. when I arrived and still there when I left at 5.55 p.m., a period of 3 hours and 5 minutes of nearly motionless incubating.

There appeared to be no consistent tendency toward more intensive incubating during the last days before hatching. FC-45 showed a higher percent attentiveness on the 10th day than previously, while FB-49 showed her lowest on that day and her highest on the last day, the 13th, with prolonged periods on but normal off the nest. By contrast, FC-49's attentiveness was from 6 to 9 percent lower on her 13th day than any earlier average, with nearly normal periods on but abnormally long periods off the nest. If we calculate the average attentiveness of all 5 females up to the 10th day, the result is 77 percent, whereas from the 10th to the 13th days it is only 75 percent.

Nice (1937: 124) found, that in the Song Sparrow "the periods off consistently decreased in length, becoming very short the last day before hatching"; 5 records of Song Sparrow incubation, taken by Kendeigh with a potentiometer (same ref.), showed no consistent change in attentiveness near the end of incubation. In the Cedar Waxwing, *Bombycilla cedrorum*, Putnam (1949: 179) found that "attentiveness heightens as incubation progresses".

**TABLE 6. — Average periods of attention and inattention relative to temperature**

Temp.	Periods on		Periods off	
	No	Av. min.	No	Av. min.
60—70°F.	13	30.0	16	9.3
70—75°F.	22	26.6	27	7.5
75—85°F.	15	20.8	14	11.5

According to Table 6, the average periods of attention of my 5 females of the Red-eyed Vireo shortened by 30.7 percent in response to a rise in temperature of 15 degrees F. and the inattentive periods lengthened by 23.6 percent. In their study of the Carolina Wren, *Thryothorus ludovicianus*, Nice and Thomas (1948: 146-147) gave data on the relationship between temperature and incubation rhythm of 17 birds. In all but one of these, the percent attentiveness decreased with rising temperature and, in all cases, the inattentive periods were influenced by the temperature in various ways and degrees.

A high temperature of 89 degrees F. on FB-49's 10th day of incubation during her third nesting obviously influenced her behaviour. The nest was watched from 9.50 a.m. to 1.50 p.m. Her first period lasted 57 min., after which she sat panting in the heat and, for apparently no other reason, kept going off and on in a manner quite inconsistent with her usually slow rhythm.

Of 11 clutches where the time elapsed between the laying of the last egg until its hatching was known, 4 sets required 12 days of incubation, 5 sets 13 days, and 2 sets 14 days. In a set of 4 marked eggs, Eggs 1, 2 and 4, in that order, hatched within 3 hours, almost to the hour 14 days after Egg 3 was laid and incubation, at least partially, began for Egg 1 and 2. Egg 4's time was 13 days and 2 hrs. Egg 3 was infertile.

In one set of 3 and two sets of 4 eggs, hatching occurred over a period of 2 days.

In 2 sets of 4 eggs, 3 hatched in one day and the 4th not at all. The remaining 6 sets of 3 eggs all hatched in one day. These data confirm the observation that incubation began, at least in part, after the laying of the 3rd egg in sets of either 3 or 4 eggs.

In the Philadelphia Vireo the incubation time is 14 days (Lewis 1929: 99), in Bell's Vireo, *V. belli belli*, 14 days (Nice 1929: 13-18) (Pitelka and Koestner 1942: 99), in the Yellow-green Vireo also 14 days according to Skutch, (Bent 1950: 327).

#### CARE OF YOUNG

The hatching of the young was observed at Nests A249 and E49. At each nest the emergence of the first young was preceded by a long attentive period, in both cases over an hour. As the young hatched, the females left, carrying away a half eggshell. I could not see what they did with it; one of them took hers to a distance of at least 75 feet.

As mentioned, none of the males was seen at the nest during incubation. But the sight of the female with the white eggshell in the bill presumably informed the male of the changed conditions there. ME visited the nest immediately, perched on the rim and inspected its contents attentively. He remained about half a minute before he flew away. Three minutes later he returned with food. This he passed to the brooding female and she, in turn, fed the young.

MA2 did not arrive before 38 minutes after the female carried away the first half eggshell, partly owing to a disturbance I created. But 4 minutes after his first visit, he returned with food and fed the young himself, the female being absent. Two minutes after she carried away the shell of the second egg, this male again visited the nest without food and inspected the young and, for the second time, brought food 4 minutes later.

There are various ways in which it is thought the males that do not incubate are informed of the hatching of their young; for instance, special flights on the part of the female or the sight of her with food in the bill, (see Nice 1943: 229-230). Some birds which eat the eggshells unknown to the males, display unusual excitement. The Song Sparrow, Nice wrote, "shows excitement, probably by flipping her wings", (p. 230). In my own experience, (Lawrence 1948: 209, 212) a Chestnut-sided Warbler, *Dendroica pensylvanica* and a Nashville

Warbler, *Vermivora ruficapilla*, both flitted about in an excited way and chipped incessantly after the first young hatched. No such excitement was noted in either of the vireo females. Putnam (1949: 166) described how the female waxwing rose revealing the young to the male, after which a "striking change in the male behaviour" occurred.

Considering the small part the Red-eyed Vireo male took in the feeding of the young in general, the promptness with which he brought his first meal is noteworthy. In some birds it may apparently take several days (Howard 1929: 27) and in the warblers mentioned above it took several hours before the males made their first visits. The females' efforts to attract the attention of the males, if so their antics may be interpreted, conceivably are not as effective a stimulus to commence feeding as the actual sight of the young, or of something pertaining to them, such as an eggshell.

The first feeding of the young vireos occurred from 1 minute to nearly 2 hours after hatching. The average rate of feeding at both nests during the hatching day with a maximum of 3 young in each nest was 3.0 per hour.

There was a striking difference in the brooding of the two females. Both days were hot, 88 degrees F. when the A-49 young hatched and 87 to 90 degrees F. for the E-49's. In spite of this, FE was off the nest less than 20% of the time after hatching began, while FA did no *bona fide* brooding at all in my presence. She merely stood over the young or on the rim for short periods, ranging from 1 to 10 minutes. The fact that Nest E was better shaded than A may account for this.

In Table 7 the gradual decrease of the brooding during daytime to virtual cessation after the 6th day is evident at nearly all the nests. The temperature which, as we saw, influenced the rhythm of incubation seemed to affect the brooding schedules little; but showers and heavy rains induced the females to remain on the nests, sheltering the young. "Shading", i.e. standing over the young or sitting on the rim, was done mostly by FA-49 and FC-49, both of which built their nests in conifers.

T. C. Stephens (1917: 25-28) found that the female did 75 percent of the feeding of the young and the male only 25 percent. My figures concerning 268 feedings come close

TABLE 7. — Brooding data

	Date	Ob. time	Temp.	Young	Age	Attentiveness			Inattentiveness		
						%	av. min.	Range	%	av. min.	Range
Nest C-45	Jul 10	107 min.	62°F	3	1 days	77	21.0	11-35	23	6.3	5-8
"	Jul 12	123 "	50-65°F	3	3 "	46	8.8	1-18	54	11.0	3-18
"	Jul 13	66 "	69°F	3	3 "	53	11.7	1-32	47	4.0	1-6
Nest A2-49	Jun 30	240 "	88°F	3	H-day*	47	3.6	1-10	53	15.9	4-68
"	Jul 4	240 "	75°F	2	3 days	57	45.7	15-89	43	34.3	5-55
Nest B3-49	Aug 4	240 "	65-75°F	2?	2 "	56	15.0	1-30	44	11.5	3-29
"	Aug 5	240 "	80-85°F	2?	3 "	40	9.1	1-20	60	16.5	4-43
"	Aug 6	240 "	65-85°F	2?	4 "	34	13.5	2-23	66	22.6	10-40
"	Aug 8	240 "	70-93°F	2?	6 "	8	6.5	6-7	92	—	—
Nest C-49	Jun 29	240 "	85°F	3	1 "	35	10.5	1-30	65	20.6	3-41
Nest E-49	Jun 30	420 "	87-90°F	3	H-day*	75	28.9	6-92	25	8.5	3-26
"	Jul 2	300 "	89°F	4	2 days	48	20.7	2-58	52	19.4	2-39
"	Jul 5	300 "	55-72°F	4	4 "	12	36.0	36	88	132.0	104-160

\* Day of hatching.

to this, 76% for the female and 24% for the male. There was, however, quite a difference in the assiduousness of individual males. MC-45 and ME-49, for instance, by far surpassed the other 4 males in diligence. Calculated from the total feedings at each nest, MC accounted for 39% at his and ME for 37%, while the other 4 males ranged from 14 to 19 percent. Only MC and ME passed food to their females to feed the nestlings.

Table 8 presents the data on the feeding of the young at 6 nests. At Nest A2-49 one young was missing on July 4 and this probably caused the drop in the feeding rate during my watch. At Nest B3-49, 2 young left the nest, but the decrease in the feeding rate during the later part of the nesting suggests that a third nestling might have died or disappeared on the 7th or 8th day. This nest was at a height of 50 feet. At 2 nests, which were watched during the fledging of the young, the rate of feeding dropped, perhaps owing to the excitement of this event and to the movement of the young into the foliage.

If the data of Nest B3-49 are omitted, the young vireos at the other 5 nests received food on an average every 50 minutes. Stephen's study (1917) also established the Red-eyed Vireo as a rather slow feeder. As to

the rate of feeding of other vireos, there is too little information to draw any conclusions, in Latimer's, Philadelphia, Bell's, none was watched longer than 17 hours.

Since, ordinarily, only one young Red-eye was fed at each visit and thus was given a whole insect, most often a sizeable fat larva, such a meal was much larger than one divided between a brood of 2 or 4 young. This would therefore compensate for the slower rates of feeding of this vireo. It happened quite frequently that a young bird refused a meal and the food was then offered to the next and, certainly, this was no indication that they were underfed. If none accepted, the parent ate the food or flew away with it.

The rates of feeding of a number of passerines show a definite increase throughout nest-life (see Nice 1943:232). In some birds, however, this increase is smaller and less noticeable but it is then, apparently, offset by larger quantities of food being given at each meal. The Red-eyed Vireo, as Table 8 indicates, belongs to the latter category. The increase in feeding rates, as shown, is rather insignificant, but the increase in the size of the meals as the young grew older was often spectacular. In evidence thereof, large dragonflies began to appear on the menu from the

TABLE 8. — Feeding the young

	Date	Ob. time min.	Young	Age	by F	Feedings		Per cent		Rate p.h.	Per young per hour
						by M	by MF	F	M		
Nest C-45	Jul 10	107	3	1 days	3	1	1	60	40	2.8	0.9
"	" 12	123	3	3 "	5	1	1	71	29	3.4	1.1
"	" 13	66	3	4 "	4	—	1	80	20	4.5	1.5
"	" 15	120	3	6 "	8	6	—	57	43	7.0	2.3
						61%	39%				
Nest A2-49	Jul 1	240	3	H-day	9	3	—	75	25	3.0	1.0
"	" 4	240	2	3 days	3	—	—	100	—	0.8	0.4
"	" 9	180	2	8 "	7	—	—	100	—	2.3	1.2
						86%	14%				
Nest B3-49	Aug 4	240	2?	2 "	11	1	—	92	8	3.0	1.5
"	" 5	240	2?	3 "	8	—	—	100	—	2.0	1.0
"	" 6	240	2?	4 "	13	5	—	72	28	4.5	2.3
"	" 8	240	2?	6 "	11	5 (3?)	—	58	26	4.8	2.4
"	" 9	240	2?	7 "	16	4	—	80	20	5.0	2.5
"	" 10	120	2?	8 "	6	1	—	86	14	3.5	1.8
"	" 11	240	2?	9 "	15	1	—	94	6	4.0	2.0
"	" 13	210	2	11 "	7	—	—	100	—	2.0	1.0 Y. left nest
						84%	16%				
Nest C-49	Jun 29	240	3	1 "	11	4	—	73	27	3.8	1.3
"	Jul 8	240	3	10 "	9	—	—	100	—	2.2	0.7 Y. left nest
						83%	17%				
Nest D-49	Jul 6	300	3	10 "	22	7	—	76	24	5.8	1.9 Y. left nest
						81%	19%				
Nest E-49	Jun 30	420	3	H-day	6	3	4	46	54	1.9	0.6
"	Jul 2	300	4	2 days	11	6	—	65	35	3.4	0.9
"	" 5	300	4	5 "	18	11	—	63	38	5.8	1.5
"	" 7	300	2	7 "	9	2	—	82	18	2.2	1.1
						63%	37%				

Note: MF—feedings passed by male to female which fed young

3rd to 5th day of nest-life and the nestling which accepted it often had difficulty in downing the giant morsel.

There was no evidence of feeding by regurgitation at any time. In the 268 feedings observed, I was able to identify the food items 75 times. Larvae, green, white, brown, yellow, in that order of frequency, including one with a reddish belly and one measuring worm, accounted for 49 feedings, or 65% of the known food items. The rest included 10 spiders (13%), 12 dragonflies (16%), 2 mayflies (3%), and 2 flies (3%).

The sanitation of the nest was carried out by both parents. Since the females attended the young about 3 times as often as the males, their part in this matter was correspondingly larger. Of the droppings recorded, the females disposed of 80% and the males of 20%.

Up to the 7th day of nest-life, the females ate the fecal sacs but began carrying them away on the 5th. The males also ate a few sacs in the beginning, but started carrying them away sooner than the females. The excreta were carried to distances varying from 5 to 100 feet. One male nearly every

time carried his far up into a tall poplar. The birds deposited the sacs on twigs, branches and the trunks of the trees, thoroughly wiping their bills afterwards.

When the young of Nest C-45 were 2 days old the female received a sac and then fed it back to the young. I found this so extraordinary that I left it unrecorded, thinking I had made a mistake, until the next day when it was repeated. The female fed one young, then picked up a dropping which she fed to another, whereupon she picked up a second sac and ate that herself. At Nest C-49, on the first day of nest-life, the same thing happened, but this time it was done by the male. He came and fed, then stood over the young for 2 minutes while he picked up several droppings, one after the other, crushed them in his bill and then fed them back to the young after which he flew.

This kind of behaviour, to my knowledge, has only been recorded once before in the literature (Sherman 1910:155). The female Northern Flicker, *Colaptes auratus*, which she was studying, "stopped feeding, solicited an excrement, obtained and ate it, after which she began feeding again — an unheard-of thing to do. . . ." Possibly this act is prompted by two stimuli of unequal strength prevailing upon the parent at the same time, that of the young presenting its food target overriding the parents' habitual reaction of swallowing or carrying away the sac.

In general, the behaviour pattern during the brooding period followed closely that of the incubation period. But there was a notable difference. The presence of young in the nest induced a nervous tension in the parents, which chiefly took expression in greater alertness, that is, a much faster reaction to disturbances.

Among the causes which gave rise to various interesting reactions in the birds at this time were the arrival or presence of "enemies", the disappearance of a young, and a certain change in the relationship between the mates particularly pronounced in very late nestings.

The first will be fully discussed in the Chapter on Defence Behaviour.

The disappearance of a young occurred at two nests. Although in no case did it actually happen in my presence, it obviously took place shortly before my arrival. In one nest one young disappeared and in the other two. The lack of response to food offerings from the

reduced broods was an exceedingly upsetting circumstance to the adult birds. For a time they were altogether thrown out of their feeding schedules. They brought food, hopped about, but never went near the nest, they displayed to each other with spread tails flipped down and uttered various mating notes, they chased off neighbouring birds which they had hitherto ignored. And all the while the female scolded with long drawn-out "miewings" and the male sang short interrupted songs or whisper songs.

At a third nest, a young died from exposure, having fallen out, been revived and replaced. It was only 2 days old and very small and featherless. Probably for this reason, it was evidently removed by the female herself, perhaps eaten, since Harding (1929: 77-80) recorded such an instance in a Red-eyed Vireo. In a fourth nest, an almost fully fledged young died of unknown causes. This one, on the other hand, was left untouched as it died, probably because, although motionless, it lay in a natural position and suggested no difference from its live brothers and sisters.

In the Red-eyed Vireo the relationship between the mates was very close through most of the nesting cycle in spite of the fact that both territory and activities were divided into pronounced male and female spheres. Also after hatching, contact between the female occupied with the young and the male in the song area was maintained through his singing and, as described, he usually stopped singing when the female joined him. When he himself entered the nest area, often in company with the female, his songs changed and took on quite a different character. Although I did not see any courtship-feeding at this time, (only the passing of food by the male to the female for the young), the meetings between the mates continued to be associated with mutual displays, sometimes becoming extravagant under emotional pressure.

But as the nesting cycle advanced, a change was noticeable, which was evidently related to the mates' decreasing need for each other after the consummation of their reproductive relationship. There came a period when the male normally retired into his song area from whence his almost continuous singing from early morning through the heat of the day proclaimed his being there alone, while the female toured the

territory on her own and for the most part cared for the surviving brood with little assistance.

With the renewed cycle of a late third nesting, the period of comparative rest which normally followed the relaxation of parental responsibilities was inhibited by the urgencies accompanying another attempt. This appeared to have a disturbing influence upon the smooth course of the birds' late nesting life and produced certain deviations from the usual behaviour pattern, which were particularly evident in Pair B-49.

Their first nest was broken up 10 days after incubation began. Their second nest was destroyed when the young were newly hatched. From their third nest 2 young emerged on August 13, an active and strenuous breeding period of 73 days for this pair.

The female was, on the whole, a phlegmatic type with slow rhythm and the male was a slow singer, which seems to be correlated with the individual's disposition. That a change was coming on them was apparent already while they were feeding the brood of the second nesting. The female came and went as if in a constant hurry, brushed past the male instead of displaying to him, and in general paid little attention to him. With the beginning of the third nesting, a natural reversal in their relationship occurred, which lasted throughout the incubation period. But after the young hatched, both mates appeared to draw apart, and thereafter only the defence of nest and territory remained a common ground where the two fully cooperated. An incident on the third day of nest-life demonstrates this change.

Both birds arrived at the nest. The female went to the nest and delivered the food which she brought in the bill. The male with nothing in the bill alighted beside the nest. At this the female gaped and snapped her bill at him. The male then swung head downwards and clung to the branch in this position, while the female stood over the nest, her body horizontal and feathers flattened, gaping. The male righted himself. Again the female snapped her bill at him, whereupon he stabbed her 3 times with his bill from behind in the region of the cloaca. She hopped over to the opposite rim of the nest, leaned across, and in turn bit at the male. He moved away from her to another branch. Here he remained, swaying his head from side to side gaping, while the female remained standing over the

nest motionless. This situation endured for 5 full minutes. Then suddenly, the female flew off escorted by the male.

After this encounter, both birds appeared "nervous" when they approached the nest. The male continued to feed the young, but performed his task in haste and never lingered even to pick up a fecal sac. When the female was there before him, he did not approach but waited well off to the side until she left. The female appeared to use more stealth when approaching than earlier observed and looked about her repeatedly before she went to the nest. At one time after feeding she flew into the foliage above the nest. Again the male came with nothing in the bill, inspected the young, flew to a branch near by and back to the nest 3 times in succession. The female saw him and gave soft "miewing" notes from her perch but did not interfere.

In an attempt to analyse this event it would seem, that the fact that the male arrived at the nest without food in the bill was the reason why the female did not react to him as to her mate. Instead she reacted to him as to a stranger. She gaped and snapped her bill at him, but she did not attack him. She stood over the young, not to protect them but in a threat posture, her body horizontal, feathers flattened, and her bill pointed towards the male and opened.

The reason for the male's arrival at the nest without food may be found in the gradual weakening of the drive to feed the young, caused by the lateness of the season and his obvious condition of oncoming moult. His response to the female's behaviour by swinging upside down on his perch, swaying from side to side and gaping, I believe to be displacement movements, derived from courtship behaviour in which swaying, gaping (see Armstrong 1942:35) and stabbing in the region of the cloaca all play a part, and brought forth by the thwarting of his intention to inspect the young birds. Inspection of the young is usually observed in the male soon after the young hatch and is, I think, a form of the drive to feed the young before this activity properly gets under way, but on this occasion occurring "in reverse" at the decline of this drive.

That the whole interlude was so prolonged without a consummatory act being reached by either bird seems to prove the low intensity of the drives in both the male and the female. It may not, however, have been actually true

but only my impression that the birds appeared "nervous" after the episode and that the Blue Jay attacks rather, which occurred with such frequency at this time, were the cause of this. The male's arrival at the nest some days later for the second time without food in the bill while the female was present and failing to make her react in any other way than to utter "miewing" notes, is probably due to the circumstance that on this occasion she was too far away from both the male and the nest.

In this study the female Red-eyed Vireo was found to be dominant in the area immediately surrounding the nest and this may, in part, have influenced the female's behaviour in this case. Nevertheless, in the incident as a whole, this does not detract from its importance of demonstrating the gradual weakening of the bond between the mates at this time as the result, it may be presumed, of the beginning retrogression of gonadal activity.

In Latimer's Vireo, Spaulding (1937:25) related many instances of the male arriving at the nest "empty-billed", in this case connected with shifts at the nest while the young were being brooded, when the female also adopted an apparently hostile attitude. Lewis (1927:42-43) described an all-out-fight between his pair of Philadelphia Vireos on the 4th day of nest-life in a first nesting, for which he could offer no explanation.

#### DEVELOPMENT OF THE YOUNG

When the young hatch they are naked except for a sparse covering of greyish natal down on the back, shoulders and head. The colour of their skin is warm reddish-yellow, like a deep sunburn. It is transparent on the belly, showing the liver as a dark area and the intestines creamy white, apparently empty. The eyes are covered by a thin film which does not show any opening. The mouth-lining is bright orange-coloured. From the first they emit an exceedingly faint note, "te", which is audible only as one stands right over them. One young bird weighed 2 grams before its first feeding.

At the age of one day, the feather papillae on the wings show like dark bands under the skin. When inactive in the nest, the position of the young is like the spokes of a wheel, heads tucked deep into the bottom of the nest, forming the hub. When the branch is jarred, the hungry nestling raises its head on

a wobbly neck and opens its mouth wide. But in a nestling which is not hungry, even though it may open its bill at the approach of the parent, the throat is kept closed by two membranes that can be seen opening and shutting like the shutter of a camera.

When two days old, the nestlings show tiny slits in the film covering the eyes. Not only on the wings but also on the dorsal tracts the dark shade of the developing feathers can be seen under the skin.

When 4 days old, one nestling weighed 8.5 grams and its length was 55 mm. The egg-tooth was lost. The feathers began breaking through the skin on all tracts. The rectrices were not yet visible with the unaided eye.

At the age of 5 days, the warm sunburnt colour of their skin disappeared. Instead it was grey-looking and wrinkled. The nestlings became rough in appearance as the feathers on the wings, the dorsal tracts and the breast broke through the skin. Their eyes were still held closed. Heads were jerked aloft at the slightest jarring of the limb. Without fail the nestlings differentiated between the vibrating movement of the limb caused by the feet of their parents as they alighted one to three feet away below the level of the nest and the gentler swaying of it caused by the wind.

When 6 days old, the weight of one nestling was 10.1 grams and its length was 57 mm. Its eyes were opening, but kept shut for the most part. The feathers were still in their sheaths. The length of the primaries was 15 mm.

When 7 days old, the feathers began breaking from the sheaths. The rectrices barely began to show. The eyes were open but still mostly kept shut. The nestlings clung strongly with their feet. Their food note, a short monosyllabic "tsep-tsep" now fully developed from the initial faint "te", was perceptibly louder.

At the age of 8 days, one nestling weighed 13.7 grams. Its length was 63 mm., wing 36 mm., tail 4 mm., and tarsus 20 mm. Feathers now covered the body fairly well except under the wings. On the head they were breaking from the sheaths and those of the wings were 3 mm. out. The natal down was being pushed away by the developing feathers but still adhered to these, especially on the scapulars and above the ears. The colour of the plumage was a velvet grey-brown with an olive tinge above, cream below, and the flanks were



faintly tinged with yellow. The young bird now kept its eyes open and when fed quivered its wings and emitted squealing notes.

On the 10th day of nest life, the young are ready to leave, but in 4 cases they remained in the nest one day longer. They have now become very active, rising and flapping their wings and getting up on the rim and preening, often returning to the nest again. In these activities they sometimes mistake each other for a parent and crouch with open bills and quivering wings, begging.

At one nest 3 young left in the course of 11 minutes, at another 2 young departed in 25 minutes, and at a third it took 3 young nearly 3 hours to be gone.

The appearance of the fledglings just out of the nest is that of small fluffy balls with exceedingly short tails. Their white and ashy brown juvenal plumage blends perfectly with their surroundings of foliage and dappled sunlight.

Often prompted by a feeding call from the parents, a very soft "miewing" note, the young hop away from the nest along the branches and make short flights, not much over one to two feet, from twig to twig. If left to themselves, they soon move away a surprising distance from the nest in this manner. Only when disturbed they may attempt a longer initial flight. One young bird, frightened by me, flung itself upon its wings in a first flight of 12 feet five minutes after leaving the nest. It failed to keep its altitude and glided rather than flew to a landing on the leaf of a wild sarsaparilla, about 7 feet lower than its take-off level. All but missing its foothold, the fledgling finally succeeded in getting itself safely adjusted on the new perch where I caught it without difficulty.

Sutton's observations on the Edwin S. George Reserve (1949:25) led him to conclude that Red-eyed Vireos' families, parents and young, do not remain together for any length of time after the young leave the nest. My observations suggest rather the opposite.

A good search of a territory at this epoch usually revealed adults and young, one parent, most often probably the male, meandering by himself and the other pursued by one or more begging young. One colour-banded young, aged 35 days, was seen tagging after its parent in their nesting territory 25 days after fledging from a first nesting. The young fed itself, but begged still and was fed occasionally.

I obtained the most complete notes on the young of Nest B3-49. At the age of 15 days, 4 days out of the nest, the young looked well grown with tails about 30 mm. long. They were fed by one parent. They were evidently moulting their juvenal plumage; the ashy brown feathers above appeared like a fluffy wadding puffing over the birds' sides and pushed up from below as the moult progressed. The new plumage which covered their bodies on the underside was white and light olive-grey. The flight and tail feathers were edged with golden yellow and were not being replaced.

At the age of 27 days, 16 days after fledging, the family was still together and the young being fed by the parent. They were seen again the next day. One of the young begged from a Black-capped Chickadee, *Parus atricapillus*. At the age of 31 days, 20 days out of the nest, the young were giving foodcalls but being fed only occasionally. Remnants of the juvenal plumage still clung to their necks and shoulders.

One month after leaving the nest, the whole family was seen together. The two young, now 42 days old, pursued the parents begging and giving foodcalls; no attention was paid to them. They had completed their moult and were evidently in full new plumage, as far as I could see at a distance.

Thus the family B3-49 kept together until the day they started out on their migration southwards, to which we shall return in a later connection.

### DEFENCE BEHAVIOUR

After the nest site has been decided, there is a marked increase in the aggressiveness of the Red-eyed Vireo, that gradually reaches a climax while the young are in the nest. After this, as the young become fledged, it declines. Evidently the boldness of action is dictated in part by the fancied or real malignity of the enemy, to which the birds may previously have been conditioned. At all times and seasons, the most intense defence action I witnessed was against Blue Jays, *Cyanocitta cristata*. A Cooper's Hawk, *Accipiter cooperii*, which occasionally hunted through the study plot in 1949 was to my knowledge not attacked. The intrepidity of the individual Red-eyed Vireo is unquestionable. A remarkable example was one bird attacking a Porcupine, *Erethizon dorsatum*, that one day crawled up a trunk 30 feet from the nest. With snapping mandibles the vireo repeated-

ly swooped and dove upon the animal, barely missing being speared upon its erect spines.

During the nest-building stage, scolding and pursuit flights were most prominent. Once, as a Blue Jay alighted in the trees of Territory B-50, both vireos began scolding insistently. Presently, one of them flung itself high into the air above the crowns of the trees and chased the Blue Jay off the premises.

After the nest acquires its quota of eggs, the female typically resorts to cryptic behaviour. Then the routine reactions include absolute immobility with all feathers flat against the body, except for the head which with raised bill imperceptibly turns to follow the movements of the intruder. The moment he gets too close, the female dives off the nest and begins scolding in loud petulant cries, "meeyaah-meeyaah". This is often accompanied by a moderate distraction display which mainly consists of the puffing of the throat feathers and the raising of the crest. At this time, when the general trend is toward secretiveness in the immediate surroundings of the nest, the scolding may or may not attract the male. But the arch enemy (Blue Jays) passing too close, or a direct attack upon the nest, requires intensified action at which both birds usually join forces. They pursue and dive upon the enemy with loudly snapping mandibles and displays of ruffled throats, raised crests, spread tails, all accompanied by scolding cries.

Late in the incubation period and after the young have hatched, the female often becomes possessed by an aggressiveness far surpassing that of the male. During their last nesting, Pair B-49 provided me with some remarkable scenes of defence action when large post-nesting parties of Crows, *Corvus brachyrhynchos*, Blue Jays and Bronzed Grackles, *Quiscalus versicolor*, almost daily trekked through the vireo territory.

One forenoon not less than 50 grackles invaded the area. The female vireo remained silent on the nest until one of the grackles came within 25 feet. Then she dashed out and attacked it single-handed, giving the "tcherrr"-note. The male joined her, giving slow songs. With "tcherrr"-notes and snapping bills the two vireos dove, snapped and pecked at the grackle with such force that it squawked and fled. One grackle returned, trying to locate the nest whose existence the vireos evidently had given away by their behaviour. The fe-

male dashed after it, the male dashed after the female, and the grackle fled. This was repeated a couple of times.

When crows came into the territory, their large size evidently caused the vireos to revert to cryptic behaviour, no slow songs, no scolding, no attack. Entirely silent they stalked the crows until these moved out of the neighbourhood. In this way, the crows evidently never surmised the presence of the nest; if they had, I do not know what would have happened.

The Blue Jays of this region have a method of hunting through occupied territories for hidden nests, which I have recorded many times and with several different species as their victims. In a noisy flock, consisting usually of groups of adults later accompanied by begging young, they enter the area and pass on with much screaming and calling. Meanwhile, one or two jays detach themselves from the crowd and in deep silence and with great wariness "sneak" from tree to tree, stopping, looking about, unmistakably searching for the nest.

During the later part of incubation to the end of the nesting of the B's, I recorded 18 Blue Jay raids, seven of these in one day. Whether or not the noisy crowd provoked the vireos or they learned the danger of the "sneaker" method, the mere sight or sound of a Blue Jay became to them like a red rag to a bull. With slight variations according to circumstances, the vireos followed a set sequence of tactics. The male, usually hopping about in his look-out treetops, instantly gave loud slow signal songs at the first inkling of an approach, going over to whisper songs as the enemy closed in. At this the female on the nest sat up, thoroughly alert. She fidgeted, looked about, and finally dove over the edge. She either joined the male and began scolding loudly, or she went to attack on her own. The snapping of the bills by infuriated vireos I know from my own experience is extremely startling. This, in combination with vicious swooping and actual stabbing with the bills, which upset the balance of the "sneaking" Blue Jay and elicited squeals and squawks of pain or fright, repeatedly and effectively kept the vireo nest inviolate.

Commonly the Red-eyed Vireo was not aggressive towards the nesting neighbours of other species and these were often admitted into the nesting tree without being rebuffed. The occasions when I saw the vireos chasing a neighbour were always in

connection with an emotional disturbance from another cause, such as for instance my approach or the disappearance of a young bird.

Once I saw what happened when another vireo came close to a nest. This was while I was watching Nest D-49. A Veery and an Ovenbird suddenly discovered me and began scolding loudly. This upset the D's which were feeding young just about to leave the nest, and they joined in the scolding. All this noise soon attracted the E's from the south. A general melee ensued, involving the Ovenbirds, a Magnolia Warbler, *Dendroica magnolia*, (the Veery withdrew), and the four vireos. The D's were torn between the urgency of scolding me and chasing the E's. FD chased the E's northwards. Having to retrace their way across D Territory to reach their own, the E's were again soundly chased by FD on the return trip too, while MD occupied himself with scolding me. The young never got their dinner that time.

#### RE-NESTING AND NESTING SUCCESS

According to Bent (1950: 338), the Red-eyed Vireo may at times raise two broods in a season. During this study, I observed only one case in which one pair possibly re-nested after having fledged their first brood.

The young of B-50 left the nest July 1. They were not seen again after this. During July and August, this pair, the male being recognized by his singing, was often encountered not far from the first site and they behaved as if they had a new nest here. When the leaves fell in the fall, I found a nest fresh for the season at this spot, hung high in the leafy top of a young aspen tree.

There are three points that favour double-broodedness in the Red-eyed Vireo. 1) The bird remains on its territory until the day it starts the flight south. 2) The nesting cycle is comparatively short, in third, second and first nestings lasting approximately 30 — 32 — 34 days, respectively. 3) The physiological condition of the species throughout its stay on the breeding grounds apparently permits, not only two nesting attempts, but 3 certainly and, perhaps rarely, four.

Single-brooded passerines, for example some flycatchers and warblers, in this latitude begin wandering off their territories in July even if both their first and second nesting attempts were unsuccessful. Therefore, by the end of July, pairs of these species are

not often to be found on their breeding territories and in August their migration is already in full swing. Third nesting attempts of the Red-eyed Vireo, on the other hand, are evidently not unusual, for which reason the bird not seldom is found nesting in the late months of summer and feeding young fresh out of the nest in September. My pair B-49 was such a case and Nice (1950: 3-4) observed a pair in Jackson Park, Chicago, which evidently also nested 3 times.

But the males' small share in the raising of the young and the lack of evidence in this study of any increase in the rate of feeding by him either at the end of nest-life or after the young are fledged certainly do not favour multiple broods in the Red-eyed Vireo. I believe that, in this northerly region, a re-nesting may only take place under special circumstances when, for example, all or most of the fledglings fail to survive soon after leaving the nest early in the season. Under such conditions, the necessary physiological readjustments in the female perhaps would have time to develop, enabling her to start a new nesting without the assistance of an accelerated male attentiveness to the first brood, which usually occurs in multi-brooded species.

The nesting success of 35 nests was 63 percent, 57 percent in 23 first nestings and in 11 second attempts 73 percent. One third nesting attempt was successful. In 30 nestings, where the number of eggs were known, 80% of the eggs hatched and 60% of the eggs fledged young (see Table 9). The two nests with 3 eggs each were "abandoned", I believe, because the females were killed by predators. I have no evidence of direct desertion by the Red-eyed Vireo either in the early stages of nesting or later. Handling of the eggs or young by the observer with reasonable care certainly had no after-effects in this way.

The causes of nesting failure included, first of all, predators. Of these the Corvidae, Crows and Blue Jays, were by far the greatest menace to the Red-eye's nests. The Eastern Chipmunk, *Tamias striatus*, and the Red Squirrel, *Tamiasciurus hudsonicus*, although numerous, were much less common causes, and hawks, the Sharp-shinned, *Accipiter velox*, Cooper's and the Pigeon Hawks, *Falco columbarius*, were a negligible danger because of their scarcity.

At one nest a crow alighted on the nesting branch in a large-toothed aspen, which

TABLE 9 — Data on the nesting success at 30 nests

EGGS		Aband.		Destr.		Not hatched		YOUNG hatched: of eggs		YOUNG fledged: of eggs		of y. hatched	
Nests													
Year	No	No	No	%	No	%	No	%	No	%	No	%	%
1941	1	3							3	100	3	100	100
1942	2	7							7	100	5	71	71
1943	3	10							10	100	10	100	100
1945	5	15	6	40	6	40			3	20	3	20	100
1946	3	9					1	11	8	89	6	67	75
1947	3	10							10	100	9	90	90
1948	2	7					1	14	6	86	6	86	100
1949	6	20			4	20	1	5	15	75	10	50	67
1950	5	17					1	6	16	94	7	41	44
Totals:30	98	6	6%	10	10%	4	4%	78	80%	59	60%	76%	

broke under its weight, throwing the nest still attached to the branch to the ground and spilling the eggs. At another a Blue Jay was caught in the act of eating one of the almost fledged young. The jay had pierced the heart of a second, which lay dead on the ground, but the third young escaped. A third nest was found with the bottom torn out, presumably by a chipmunk, and a fourth with 4 young apparently eaten by a Red Squirrel in the course of a couple of days. In a fifth nest heavy rains caused it to sag at so steep an angle that one young was kicked out by the female and later died from exposure.

Parasitism of the Red-eyed Vireo's nests by the Cowbird, *Molothrus ater*, was not observed in this study, notwithstanding that female Cowbirds roamed the area every year up to 1948 and many species were known to be parasitized, such as the Chestnut-sided, Nashville and Myrtle Warblers. In other localities, observers have found the Red-eye to be the most common victim of the Cowbird, (Bent 1950: 344), (Sutton 1949: 23-25).

FEEDING HABITS

The overwhelming percentage of the Red-eyed Vireo's food was taken from the foliage of deciduous trees during the whole time of its stay on the breeding-grounds. The underside of the leaves were the objects of its special attention since this is the place where many insects and larvae dwell.

The Red-eye glides rather than hops along the branches foraging. Attentively it examines the leaves overhead and on all sides. Espying a larva, the bird often lifts itself to snatch the morsel with a graceful movement of the wings, its feet trailing, alights

again, and then smites the prey dead against the branch. At other times, it may suddenly turn a half somersault and with its feet clinging to a swaying cluster of leaves pick its food in an upside-down position.

Kendeigh (1947: 56) made special note of this upside-down feeding of the Red-eyed Vireo in the Black Sturgeon Lake area where he observed it in conifers from branches that appeared too weak to support the bird's weight. For this reason he attributed this feeding method to a "geographical variation in the normal behaviour pattern of the species that aided it to inhabit the spruce-fir forest..." In this study, the upside-down feeding was commonly seen but only in broad-leaved trees from clusters of leaves that hung down perpendicularly and therefore were conveniently reached in this manner.

By reason of his general habits, the male foraged principally in the crowns of the trees down to the middle branches and, as he escorted the female, occasionally in bushes. The female, with nests often suspended from low branches, quite frequently also foraged near or even on the ground where she picked small stuff, such as ants and snails.

According to Bent (1950: 339), six-sevenths of the Red-eyed Vireo's food is animal and the rest wild fruits. The red cherry, *Prunus pennsylvanica*, appears to be a favourite. It is eaten whole and is fed to the young after they have left the nest.

In spite of the fact that the study area was in possession of plenty of water, the lakeshore on two sides and also a small creek and a spring with overflow, I never saw the Red-eyed Vireo either bathing or drinking

at any of these places. Presumably the succulence of its larval food together with dew and raindrops provide the bird with the liquids it requires.

### VOICE

For the best technical description of the Red-eyed Vireo's song the reader is referred to Saunders (1935: 169-170).

Two distinctly different songs were recorded, the courtship-song and the song phrase theme.

On a few occasions during the nest-building I heard the courtship-song. It was a mellow warble that reminded me of the song of the Rose-breasted Grosbeak. Sometimes it was quite prolonged, at other times abbreviated, and every time I heard it, it was given *sotto voce*. Saunders, quoted by Bent (1950: 335), described a courtship-song he heard in the Allegany State Park on July 28, 1933, that was given in a soft whisper.

Several variants of the song phrase theme were given so consistently under the same conditions that I have recognized them as separate "songs". They varied in delivery, speed and continuity. Four of these I have recorded as the most important: the advertising song, the alert song, the contact song, and the signal or nest song.

1) The advertising song was loud, clear, and comparatively slow in tempo. It advertised occupied territory and was therefore heard most often during the pre-nesting period and in August.

2) The alert song was also of slow tempo, sometimes with prolonged intervals between the notes, and it was usually of longer duration than the signal song, which it resembled. It was given either with full voice or *sotto voce*. Its objective was primarily to alert the female, but perhaps also to intimidate the "enemy", especially the whispered version.

3) The contact song was given at the bird's highest speed of delivery, often in protracted sessions, and seldom used outside the song area. As explained earlier, it served to maintain the contact between the pair when the male was not with the female.

4) The signal or nest song was loud and slow consisting at the most of 2 to 4 phrases. With this song the male called the female off the nest during incubation and brooding and he often sang it as he approached the nest to inspect or to feed the young.

A notable difference in the mode of singing was observed in the various males. Male A2-49, for instance, was a medium slow singer, (40 — 65 s.p.m.), with a strong, clear quality of tone. Males C, E and F-49 were fast and continuous singers (50-85 s.p.m.), especially in the period from late incubation to the post-nuptial moult. MF took the prize as a fast performer when he was clocked one morning in July at 85 s.p.m. Of these three, judging by their singing and the location of their territories, MC and ME returned again in 1950 and were heard in the same song areas giving the same types of performances. The singing of Male B-49 was most distinctive. It was unhurried (25-50 s.p.m.) with longer intervals between the phrases and the quality of tone was beautifully liquid. His phrases were often interrupted and seldom given in protracted series. I am sure that Male A-50, occupying the same territory, was in fact the same bird because his singing was of exactly the same type as that of MB-49.

As a rule, the slower singers were not given to the incessant series of singing, considered so typical of the Red-eyed Vireo, as were most of the faster ones. Without recourse to banding, reliable observations on age and manner of singing could not be made. But, assuming that the 3 males mentioned above actually returned in 1950, I could detect no difference in their singing that might be attributed to better practice or faster performances from year to year.

The singing in May, described in detail under Pre-nesting activities, was notably less insistent and slower as compared to that in the later stages of the nesting cycle. But with the beginning of incubation and the retirement of the male into the song area, a distinct increase both with regard to speed and volume occurred, which gradually led to a climax about the last two weeks of July, or about a week earlier after successful first nestings. This climax lasted until the post-nuptial moult began. During this time, the birds sang only slightly less after noon than they did in the morning. This was natural since the meaning of the male's singing at this period was primarily to keep in contact with his mate when she was out of his sight, occupied with her nesting duties. In contrast to the thrushes, the Red-eyed Vireo decreased his singing in the evening and ceased altogether comparatively early.

TABLE 10 — Data on late summer singing in 1949 by 4 males

a	July							August																			
	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
Male B-49	S	—	S	—	S	S	—	S	—	S	S	S	S	S	S	—	S	S									
Male C-49	S					s*				s		s							S	—	S	S	—				
Male E-49	S	—	S	S	S	S	—	S	—	S	S	S	S	—	S	—	S	S	—	S	S	S	—	S			
Male F-49	—	—	—	S	S	—	—	S	—	S		S	S	—	S						s	s	s				
Blue Jays						X		X			X	X	X	X	X		X					X					
Migrants						X				X		X	X				X			X		X	X				
No app. reason			X	X	X																						

b	August										September													
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10
Male B-49						s			s						S	—	S							
Male C-49	—	—	—	—	S	S	S	S	S	S	—	—	—	—	—	—	S							
Male E-49	S																		S					
Male F-49						s				s							S							
Blue Jays																								
Migrants	X				X	X	X	X	X	X	X				X	X	X	X						
No app. reason																								

\* Small s Symbols means insignificantly short song periods.

In most cases, day singing diminished during the last weeks of July. Thereafter nearly all the singing occurred in the early morning, beginning 30 to 35 minutes before sunrise and ending seldom later than about 11 a.m. Now the singing also changed its meaning. At this time the migration of the warblers and other small passerines was rapidly coming to a head and many flocks of these birds passed through the vireo territories during the morning and early forenoon, evidently creating the urge in the Red-eyed Vireo to advertise his territory anew. With few exceptions, the records of August singing were in connection with the passing through the territories of groups or "waves" of migrants.

Table 10 shows the singing of 4 males during the late part of the summer 1949 and the reasons for the singing checked (x) below.

In one way it may be said, that these 4 males were in song practically throughout the post-nuptial moult. A closer analysis indicates, however, that each male went through a period, relative to the fledging of his young, when he was virtually silent except when migrants or Blue Jays prompted him to let himself be heard briefly.

Male B fledged young on August 13 and was moulting heavily during the last stages

of the nesting until the end of the month. He sang briefly only twice between Aug. 11 and Sept. 2, an interval of 22 days. His first post-moult song was decidedly "rusty". Male C fledged young on July 10 and he sang only 3 times between July 25 and Aug. 13, an interval of 19 days. Male E probably re-nested twice more after his first nest was robbed on July 8. He stopped singing between Aug. 18 and Sept. 5, 17 days. Male F fledged young in the end of July and stopped singing from Aug. 8 to Sept. 3, with the exception of 5 brief sessions of song during this time. Thus, the average period of virtual cessation of song in these 4 males was 21 days. The table also shows a revival of song from Sept. 2 to 5. After this, 3 of the males disappeared from their territories, having presumably left on their migration south.

I have no evidence of female song. I heard no singing from the nest at any time. Sutton (1949: 36) found that the young males learn to sing before migration. The reason why I heard no singing by young birds may be that the migration date on the George Reserve, Michigan, is later than that at Pimisi Bay, or indeed that I missed it.

Seven different call-notes were recorded. 1) The scolding note, the common petulant "meeyaën, meeyaën", nasal and longdrawn,

was not heard until the female appeared in the territory. Both she and the male used it constantly during the nesting season and often during the passing of migrants in August when the male was not singing. The female's note was a fraction more prolonged than the male's. The note was nearly always accompanied by displays, ruffled throat, raised crest, tail spread and flipped down.

2) The intimidation note was a rasping rolling "tchëerrrr", something between the Veery's and the Baltimore Oriole's scolding notes. It was used to rebuff an intruder during fights and defence actions.

3) The mates' mutual meeting note, which I have also called the mating note, was a rather soft "aërrrr". It was always heard when the two came close to each other.

4) The female's special call to the male was a soft "quot-quot". It was used during courtship and displays, as was

5) the male's special call to the female, a soft "tetetetet" or a twanging "tetewtewtew".

6) The female's begging note, a monosyllabic "tchet, tchet, tchet".

7) The food call of the young, almost identical, "tchirt, tchirt, tchirt".

Once or twice I heard two additional notes, one that seemed to be a nest-note and given by a female during nest-building, and the other a feeding call by parent to young during fledging. Neither of these notes was heard enough to attempt classifying.

The "odd" notes included in some Red-eyed Vireos' repertoire and reminding observers variously of a flycatcher or a thrush are, I believe, individual peculiarities with no bearing on other factors. A vireo with such a note was present in a neighbouring area in 1944. In the study plot, a White-throated Sparrow, *Zonotrichia albicollis*, featured a similar note literally superimposed upon his usual whistled song in the very middle. This bird was heard in the same territory for 5 years.

#### DEPARTURE FROM THE NESTING GROUNDS

Soon after the revival of song in the first week of September, the Red-eyed Vireo left the nesting grounds. September 15 was the latest date for a bird known to have been a resident. The average latest fall date for the Pimisi Bay region over 6 years was September 19, ranging from September 6 to 28.

In a work just published, Sveriges Djur, Faglarna, (Sweden's animals, the Birds, 1951: 106), Dr. Gunnar Svårdson wrote in his chapter on the Riddle of Migration: "At the start... the bird sometimes has a kind of "inner inertia" to overcome... It is as if they were fastened to the locality from which they are about to depart with an invisible rubberband... As this "hesitation" is mastered, the departure takes place without further ado. That this is a conflict between an urge both to remain and to leave at the actual moment of departure, which releases this behaviour, is demonstrated by the fact that migrants passing the place where the hesitating birds are, fail to be influenced by them."

On September 15, at 9.30 a.m., two members of Family B-49, which had been constantly followed since the ending of the nesting on August 13, moved away from their territory along the lakeshore with a flock of passing warblers. The vireos, an adult and a young, seemed much excited, flying to and fro, and the young one pursued the parent with food calls. Their "hesitation" whether or not to go on with the warblers was obvious. They followed the migrants about 400 feet from the edge of the territory, flitting hither and yon, as if unable to make the final decision. Then, all of a sudden, both vireos turned about face and flew directly back to the B's favourite feeding spot where they began foraging quietly. The warblers passed on across the highway. But later in the day, the vireos left for good, and this time there was no return.

#### SUMMARY

1. The study was conducted in the region of the headwaters of the Mattawa River in central Ontario and in a 16-acre plot along the southeast shore of Pimisi Bay. The land is in the ecotone between the Temperate Deciduous Forest and the Northern Coniferous Forest.

2. The Red-eyed Vireo was found in deciduous and mixed woodlots and in lighter areas of coniferous forests. It was absent where there was no underbrush and, in agreement with Kendeigh (1947: 56), where less than 25% of the total basal area was covered by broad-leaved trees.

3. The Red-eyed Vireo was among the later migrants. The median first arrival date in the Pimisi Bay area was May 19. The median temperatures of the first arrival date were: max. 64 and min. 39 degrees F.



4. In 10 out of 11 years, the first arrival dates were preceded or accompanied by warm weather and SW winds. In 1948, cold weather was evidently the cause of a delayed first arrival date in this locality. In 5 cases of mated pairs on given territories, the females arrived from 3 to 15 days later than the males.

5. During a short interval just after arrival, the Red-eyed Vireo sang very little. The arrival of other males of the same species set off more energetic singing, but the volume of territorial singing during the pre-nesting period depended to some extent on whether many males settled close together in the immediate surroundings, as well as on the individual.

6. The male ranged over a greater area before than after the arrival of the female. This was taken to be an important part of his territorial behaviour, by which the resistance of neighbouring male vireos was sounded out. Thus it became one of the determining factors in the mapping of the final territory. Another factor was the female's indication of a preferred nesting area.

7. The ecological requirements, "key-aspects" (Miller), of the Red-eyed Vireo were light, groups of tall trees, and thickets of younger growth. The territory was divided into two parts, one the "song-area" used especially by the male and the other, the "nest-area", principally belonging to the female. The average size of a territory in a crowded year (1949) was 1.4 acres and in a year with fewer pairs (1950) 2.1 acres.

8. The introduction of the female to an unmated male in one instance was characterized by pursuit and "pouncing". The female showed less inclination to copulate before than after nest-building.

9. The female chose the nest site and to reach a decision she took from 5 to 6 days in first nestings, from 3 to 4 in second, and in one third nesting half a day or merely a few hours.

10. Of 44 nests, 77 percent were built in deciduous trees and bushes and 23 percent in conifers. The height varied from 3 to 55 feet and tended to be increased in later nestings. The nesting site was in a variety of situations, but a dense "protective area" nearby was essential.

11. Nest-building normally required from 4 to 5 days and was performed by the female with no help from the male.

12. The interval between the completion of the nest and the laying of the first egg varied from several hours to 4 days. The average set of eggs was 3.3. Clutches of 4 eggs were most common in first nestings.

13. The female alone incubated. The incubation period was from 12 to 14 days and incubation started after the third egg was laid in sets of either 3 or 4 eggs. The male did not visit the nest during incubation, but contact between the mates was maintained through the singing of the male. Seven out of 8 times the male called the female off the nest by signal calls or songs. The female joined the male during the periods off the nest. Courtship-feeding was an important feature of these intervals, especially during incubation. The attentiveness of 5 females averaged 76 percent; the average of 38 attentive periods of 4 females was 29.2 min. and of 46 inattentive periods 9.9 min.

14. As soon as the young hatched, the female carried away the eggshells. This appeared to be the signal for the male to visit the nest, soon after which he brought his first meal. While in the nest, the young were fed 3 times as often by the female (76%) as by the male (24%). Some males were more attentive than others. The feeding curves of the male and the female at one nest converged up to the 6th day of nest-life, and then sharply diverged. The increase in the rate of feeding during nest-life was less marked than in most other small passerines, but the size of the meals was notably increased as the young grew older. The young at 5 nests were given a meal each on an average every 50 minutes. The fecal sacs were eaten and carried away by the female and mostly carried away by the male.

15. The young were almost naked on hatching, but at 7 days the feathers began breaking through the sheaths, and at 8 days the young were fairly well feathered. Slits in the covering of the eyes appeared on the second day and the eyes were kept fully open on the 8th day. Young were fledged on the 10th, in some cases on the 11th day. They were fed by the parents until between 25 and 30 days after leaving the nest. They completed their juvenal moult during this time, which did not involve flight and tail feathers.

16. The aggressiveness of the Red-eyed Vireo increased with the progress of the nesting cycle and then decreased after the young were fledged. During incubation cryp-

tic behaviour was typical. In later stages the female became more aggressive than the male. In this region Blue Jays were the vireos' worst enemy. Birds and other predators of the size of jays, or smaller, were usually attacked with snapping mandibles and sometimes bodily assaults with the bill. Larger predators, crows and hawks, were stalked in silence and only attacked as a last resort. Neighbouring nesting birds of other species were usually tolerated and rebuffed only when the vireos found themselves under some stress. Trepassing vireos were chased.

17. No reliable evidence was obtained of the Red-eyed Vireo raising 2 broods in a season. One and two re-nestings occurred after unsuccessful attempts. The nesting success of 35 nests was 63%; it was higher in second than in first nestings. The success of the eggs in 30 nests was 60 per cent. No nests were parasitized by the Cowbird.

18. The Red-eyed Vireo foraged chiefly on the higher levels of the trees and its food was nearly all animal.

19. The singing of this vireo was influenced by individuality, time in the nesting cycle, and the purpose of the song. Some males were much faster and more persistent singers than others. The longest and most continuous sessions of singing, irrespective of the time of day, occurred after incubation began until about one or two weeks after the young fledged in July. In 4 males, there was a virtual cessation of singing during the post-nuptial moult, averaging 21 days. During August nearly all the singing was territorial and mainly due to the passing of migrants through the territories. One courtship-song and 4 variants on the song phrase theme were recorded, as well as 7 call-notes.

20. At Pimisi Bay, the fall migration of the Red-eyed Vireo took place during September. The mean last fall date for 6 years was September 19 and the latest date of departure of a bird known to have been a resident was September 15.

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## A COLONY OF THE LAND SNAIL *CEPAEA NEMORALIS* (L.) (HELICIDAE) IN THE VICINITY OF LONDON, ONTARIO<sup>1</sup>

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THE OCCURRENCE of the land snail *Cepaea nemoralis* (L.) in southern Ontario has been noted by Pilsbry (1928, 1939), Latchford (1930) and others and its distribution in this region has been summarized by Oughton (1948) who makes reference to a living snail collected by H. B. Hitchcock in

London. During April of 1952 the writer located a colony of this species of snail in Westminster Township near the western limits of the city. The snails were abundant in grassy plots at the southern end of Greenwood Street. They were concentrated almost entirely in three adjacent residential lots on the west side of the street and, opposite

<sup>1</sup> Received for publication May 10, 1952.

these, in four lots on the east side of the street. Each of these groups of lots comprised an area of dimensions about 100 yards by 75 yards. Outside these areas the shells were sparsely scattered. The snails were first seen on April 23 when several shells were found embedded in mud and a few live snails were noted. On April 27 more than 1,000 shells were collected in an hour. The grass had recently been burned and many of the shells were lying exposed on the ground and had been scorched. Others were found in clusters beneath loose moss and in cracks in the soil. About 40 live snails were collected and were placed in a glass bowl, being fed on lettuce. Several shells were examined by Dr. J. Oughton, Ontario Agricultural College, Guelph, Ontario, who kindly identified the species as *Cepaea nemoralis* (L.).

Residents in the vicinity reported that the snails had been present in considerable numbers for at least ten years and that during damp weather they would crawl over sidewalks, up the sides of buildings, on the leaves of garden plants and over the trunks and leaves of trees. It was asserted that the snails did not cause noticeable damage to foliage.

*Cepaea nemoralis* is a pentataeniate species, having five bands on the shell, three above the periphery and two below. The distribution of these bands has been studied by several authors in shells taken from various localities and the frequencies of the variations in the banding pattern have been tabulated. The inheritance of the banding pattern has been investigated by Stelfox (1918). In North America the banding of the shells in a colony at Lexington, Virginia was studied by Howe (1898) and again by McConnell (1935) in 1930. McConnell compared his findings with those of Howe to show what changes had occurred in the frequencies of the variations of the banding pattern over the intervening years.

From the colony at London, 1,000 mature shells have been studied and the banding patterns have been examined. The frequencies of the different patterns occurring in these shells are presented in Table 1, the band formula used being that adopted by McConnell (1935). Howe did not distinguish between complete and partial fusion of bands, but McConnell did, indicating complete fusion of bands by round brackets and partial

fusion by square brackets, e.g. complete fusion of bands four and five: (45), partial fusion: [45].

In the colony at London, the predominant patterns are those which have five separate bands: 12345, three separate bands with four and five partially fused: 123 [45], and three separate bands with four and five completely fused: 123 (45) (Table 1). The other twenty-

Table 1. — Frequencies of banding patterns occurring in 1000 shells.

Pattern	Frequency	Pattern	Frequency
#12345	353	123 <sub>4</sub> 5	1
#123[45]	429	02345	8
#123(45)	102	0(23)45	1
1(23)45	1	023[45]	2
1(23)[45]	1	023(45)	5
1[23]45	2	020[45]	2
1[2345]	1	020(45)	1
12(345)	1	003[45]	1
#(12)3[45]	1	#10345	1
#[12]3(45)	19	#12045	7
[123][45]	1	[12]045	2
#[12345]	15	120[45]	4
# <sub>1</sub> 2345	13	<sub>1</sub> 2045	1
# <sub>1</sub> 23[45]	19	<sub>1</sub> 20[45]	2
# <sub>1</sub> 23(45)	3	12305	1

# : Patterns recognized by McConnell (1935).

seven patterns recognized are present in much smaller numbers. This distribution of frequencies contrasts strongly with that found by McConnell (1935) in the colony at Lexington where 31% of the shells were bandless: 00000, 11.2% showed band three only: 00300, while five separate bands: 12345 occurred on 19.5% of the shells and other patterns showed less frequently. Bandlessness has been shown by Stelfox (1918) to be dominant and in the colony at Lexington the proportion of bandless specimens increased approximately five-fold during thirty-two years. Bandlessness did not appear in any of the shells found at London. If it had occurred it probably would have become predominant over the ten years during which the colony has evidently been present. The distribution of banding patterns in this colony, with the predominance of many-banded snails, indicates that it more closely resembles European colonies, in which banding predominates (Stelfox, 1918), than it does the colony at Lexington.



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NOTES ON ELLESMERE ISLAND BIRDS<sup>1</sup>

W. EARL GODFREY

*National Museum of Canada, Ottawa*

RECENTLY the National Museum of Canada received two small bird collections from Ellesmere Island, N.W.T. John S. Tener, Mammalogist, Canadian Wildlife Service, spent the period April 19 to August 24, 1951, at Eureka, Slidre Fiord, in the central western coastal area of the island, during which time he covered most of the Fosheim Peninsula. In addition to his mammalogical investigations, he made valuable notes on the birds; and, for the National Museum, he brought back a collection of 35 well-prepared bird skins. Mr. Tener generously made his bird field data available for use in the present connection and all field data here recorded from the Slidre Fiord region are his.

S. D. MacDonald, of the National Museum staff, spent the period April 14 to September 30, 1951, collecting and observing birds and mammals in the vicinity of Alert, in the northeast coastal part of Ellesmere Island. He secured 73 birds. Mr. MacDonald's report will be published in the forthcoming Annual Report of the National Museum of Canada, for the Fiscal Year 1951-52; consequently only occasional reference is made here to his observations, except in the case of species of special taxonomic interest.

In addition to the two collections mentioned above, the writer has examined a few Ellesmere Island specimens, also in the National Museum, taken by J. Dewey Soper in 1923, R. M. Anderson in 1928, and John Kelsall in 1948. Affinities of the Ellesmere Island birds with the Greenland avifauna are

noteworthy, involving breeding range extensions of such Old World races as *Arenaria interpres interpres*, *Calidris canutus canutus*, and probably *Acanthis hornemanni hornemanni*, into Canada.

**Red-throated Loon.** *Gavia stellata* (Pontopidan)

Tener saw a pair on June 16 at Slidre Fiord, and on June 23 he located a nest with one egg on a small point at the edge of a pond south of Eastwind Lake. He estimated the Slidre Fiord area population at about four breeding birds.

**Brant.** *Branta bernicla* subsp.

Eleven in northerly flight on June 7 was Tener's only observation.

**Greater Snow Goose.** *Chen hyperborea atlantica* Kennard

Specimen examined:

Alert area: 1 juv. ♂ (?), August 14, 1951.

MacDonald secured a flightless juvenal, the head and neck of which are still mainly downy, on August 14 at Hilgard Bay, near Alert. Two adults accompanied it. At Slidre Fiord, Tener's earliest observation was on May 31 when seven were seen. Later small flocks were noted which broke up into solitary pairs shortly after arrival. Tener saw 32 moulting birds on Romulus Lake, two miles east of the end of Slidre Fiord, on July 8. These were unable to fly. He encountered no evidence of nesting.

Although the Alert juvenal examined is not subspecifically identifiable, the writer has examined adults of *atlantica* from Devon

<sup>1</sup> Received for publication May 10, 1952.

Island and there appears to be little reason to doubt that the Ellesmere Island birds are also of that race.

**Old-squaw.** *Clangula hyemalis* (Linnaeus)

First noted at Slidre Fiord by Tener on June 16 when two pairs were seen. Flocking of males was observed early in July.

**King Eider.** *Somateria spectabilis* (Linnaeus)

Tener first observed it at Slidre Fiord on June 16 when two pairs were noted. Males in flocks were seen early in July but not after July 9.

**White Gyrfalcon.** *Falco rusticolus candicans* Gmelin

Specimens examined:

Slidre Fiord: 2 juv. unsexed; September 4, 1950.

Craig Harbour district: 1 near-adult unsexed, 1939.

Tener observed one at Slidre Fiord on August 13, 1951, and he secured two specimens that had been collected there by D. Simon on September 4 of the previous year. MacDonald, in the Alert area, observed single birds on May 23, June 10, 28, 29, and 30; saw three on June 25; and six on both June 27 and 28. All individuals seen by both observers and the specimens collected were white-phased. Neither observer found evidence of breeding.

Salomonsen (1951) who has examined a very large series of specimens from Greenland and has had extensive field experience with the species, considers *candicans* a valid subspecies. A great deal more breeding material from Canada is needed to shed light on the perplexing taxonomy of this species.

**Rock Ptarmigan.** *Lagopus mutus* subsp.

Specimens examined:

Craig Harbour: 2 ad. ♂, 1 ad. ♀; June 12 — July 10, 1936.

Slidre Fiord: 2 ad. ♂; May 28 — June 13, 1951.

Wing (flattened) measurements of the specimens listed above are (in mm.): Craig Harbour, 2 ad. ♂, 204.5, 197.0; 1 ad. ♀, 195.0. Slidre Fiord, 2 ad. ♂, 205.0, 205.5. Their large size indicates tendencies toward *captus* but these are less pronounced than in a larger series examined by Salomonsen (1951) from northwest Greenland (Ingfield Land and Thule District) and northeastern Northwest Territories (Ellesmere Island and Axel Heiberg Land) which measured: 14 ♂, 206-

212 mm.; 9 ♀, 192-208 (one 187). Salomonsen regards the latter series as *captus* ↔ *saturatus*. However, Salomonsen considers the perplexing breeding populations of Baffin Island (except the southern part) closer to *saturatus* than to *rupestris* in which case the Ellesmere Island birds would indeed be *captus-saturatus* intergrades. The A.O.U. Checklist Committee (1952), however, gives its conception of the range of *saturatus* as that part of western Greenland between the Upernavik District and the Egedesminde District and presumably still regards Baffin Island populations as being nearer *rupestris*. In the latter case, Ellesmere Island birds would seem to be *captus-rupestris* intergrades. The writer does not have access to adequate Greenland material and therefore is unable to express an opinion on the subject at this time.

**Ringed Plover.** *Charadrius hiaticula hiaticula* Linnaeus.

Specimens examined:

Alert area: 1 ad. ♂; July 18, 1951.

On July 18, MacDonald saw two in the Alert area, one of which he collected. It had a brood patch and the testes measured 6 mm. It agrees with the nominate race in lacking a distinct web between the basal parts of the inner and middle toes and in possessing a broader pectoral band than in *semipalmatus*; but it is small (wing, 125; exposed culmen, 13.8 mm). Schiøler (1915) pointed out that specimens from Greenland and Iceland average smaller than birds from southern Scandinavia and he applied the name *septentrionalis* of Brehm to the smaller birds. Salomonsen (1930), however, showed that this name cannot be used and he proposed a new name *psammodroma*. More recently, however, Salomonsen (1951) found the alleged smaller size of Greenland and Iceland birds too inconstant to merit separate subspecific status for them. Earlier Peters (1934) expressed doubts as to the propriety of recognizing *psammodroma*. The Ellesmere bird is therefore here referred to the nominate race despite its small size.

**European Turnstone.** *Arenaria interpres interpres* (Linnaeus)

Specimens examined:

Alert area: 6 ad. ♂, 2 ad. ♀, 1 juv.; June 13 — July 30, 1951.

Slidre Fiord: 7 ad. ♂, 3 ad. ♀; May 31 — June 14, 1951.

Slidre Fiord: 2 juv.; August 28, 1948.

Craig Harbour: 12 juv.; August 6-12, 1923.

Craig Harbour: 2 juv.; August 9, 1928.

Although intermediate in size between the nominate race and *morinella*, the 18 adults from both Alert and Slidre Fiord are in colouration (much restricted cinnamon-rufous areas and correspondingly much more extensive black areas as compared with *morinella*) decidedly closer to the European bird and the writer has little hesitancy in referring them to the nominate race. The crowns of the Ellesmere Island adults also are more heavily streaked than in birds examined from other parts of Arctic Canada. The series of 17 immatures from Ellesmere is remarkably uniform and differs surprisingly and definitely from a series of 22 comparable birds from other parts of Canada, the former being much darker above including the crown and nape. Only 3 of 22 specimens of *morinella* (Go Home Bay, Ontario, September 20, 1902; Port Frank's, Ontario, September 5, 1883; and Last Mountain Lake, Saskatchewan, August 19, 1920) closely approach the palest extremes of the Ellesmere Island series. The only considerable tendency of the Ellesmere Island series toward *morinella* is in size as is shown by the following wing measurements (in mm.):

Alert area: 5 ad. ♂: 145.0-152.5 (av. 147)

Slidre Fiord: 7 ad. ♂: 142.0-154.0 (147)

Alert area and Slidre Fiord: 4 ad. ♀: 149.0-152.6 (150.9)

This species was first noted at Slidre Fiord by Tener on May 31 when eight were seen. At Alert, MacDonald's first date was June 2, when one was noted. Latest date on which it was seen at Slidre Fiord was August 20; at Alert, September 1. Tener noted large flocks at Slidre Fiord until June 3. After that date the flocks were broken up into courting groups of a female and one or more males. After June 14 only paired birds were seen on their territories. Nesting appeared to be confined to dry ridges and gentle slopes covered with *Dryas* and some *Cassiope*. Young were seen flying short distances on July 24 and 25. This race was not previously known to breed in Canada.

**Old World Knot.** *Calidris canutus canutus* (Linnaeus)

Specimens examined:

Alert area. 3 ad. ♂, 2 ad. ♀, 1 juv. ♂, 1 juv. ♀, 2 downies; June 16-August 11, 1951.

Slidre Fiord: 2 ad. ♂, 2 ad. ♀; June 3-7, 1951.

Most ornithologists heretofore, presumably because of lack of adequate study material, include northwestern Greenland and Ellesmere Island in the range of the American *Calidris canutus rufa*. Conover (1943), however, referred all Greenland material to *canutus* and recently Salomonsen (1951) did the same. The latter was able also to examine specimens in the British Museum from Discovery Bay and Floeberg Beach, both in Ellesmere Island, and these specimens too he referred to the nominate race. The material listed above also is unquestionably referable to *canutus*.

In the Ellesmere Island adults the dorsel aspect is markedly darker than in specimens of *rufa* from other parts of Canada. The black areas are much more extensive and the buffy parts are both more extensive and darker. Ventrally the rufous colour of the Ellesmere Island birds is darker and this colour extends, except in one female, posteriorly to include the under tail coverts. In the two birds from Alert, the grey colour of the upper parts is trenchantly darker than in any of the nine specimens of *rufa* of similar age and season with which they were compared. The pale edges of the feathers of upper back, scapulars, tertials, and wing coverts are buffy instead of white. The two downies from Ellesmere Island are a little buffier (less greyish) than are four from eastern Victoria Island, N.W.T.

This species was first noted at Slidre Fiord on May 27 when Tener saw one. On June 3 he noted more than 75. Courting was observed for about two weeks, then not at all. A nest with four eggs was found on top of an 800-foot sandstone ridge on June 23. Downies, only a few hours old, were in another nest on July 12. Young able to fly short distances were seen on July 23. Tener concluded that this species prefers, as nesting habitat on Fosheim Peninsula, weathered sandstone ridges and elevations, characteristically vegetated with scattered clumps of willow, dryas, and poppy.

**Sanderling.** *Crocethia alba* (Pallas)

Specimens examined:

Alert area: 1 ad. ♂, 2 juv. ♂, 2 juv. ♀; June 25-August 9.

Tener saw an adult with three young thought to be not more than 12 hours old in the Slidre Fiord area on July 12. He saw no others.

**Long-tailed Jaeger.** *Stercorarius longicaudus* Vieillot.

Slidre Fiord: 3 ad. ♀; June 7-13, 1951.

Alert area: 2 ad. ♂, 3 ad. ♀, 1 sub-ad. ♂, 1 sub-ad. ♀; June 14-30, 1951.

Earliest individual noted by Tener in the Slidre Fiord area appeared on June 7. Five were observed on June 13 and the species was noted on almost every later trip afield. Although behaviour of adults strongly suggested breeding, diligent search failed to reveal actual location of nests. Stomach of the June 7 female contained feathers and bone of what appeared to be a Snow Bunting. An adult female taken on June 13 had eaten three moth caterpillars and the stomachs of single females taken on June 15 and 17 were empty.

Salomonsen (1951) states that American birds and those of Greenland are paler than European birds and he calls the American and Greenland specimens *S. l. pallescens* Løppenthin. Shortt (1951) says that this view is borne out by specimens in the Royal Ontario Museum of Zoology. No European material is at present available for examination by the writer.

**Glaucous Gull.** *Larus hyperboreus hyperboreus*. Gunnerus

Tener saw two on June 3 and six were present in the Slidre Fiord area during the summer.

**Herring Gull.** *Larus argentatus* subsp.

Two individuals, probably *thayeri*, were seen by Tener at Slidre Fiord on June 12.

**Arctic Tern.** *Sterna paradisaea* Pontoppidan  
Specimens examined:

Slidre Fiord: 1 ad. ♂; June 17, 1951.

Alert area: 4 ad. ♂, 1 ad. ♀; June 22-August 9, 1951.

In the Slidre Fiord area Tener first observed this tern on June 16. Stomach of a male collected revealed that it had been eating the amphipod *Pseudalibrotus*. A nest found on July 14 contained one egg. Two nests on July 23 contained newly-hatched young.

**Short-billed Guillemot.** *Cephus grylle ulimus* Salomonsen

Specimens examined:

Alert area: 1 ad. ♀; July 30, 1951.

Fram Haven: 1 ad. ♂; August 3, 1928.

While not quite typical in size (length of exposed culmen 27.7 and 29.0 mm.) these two specimens appear to be best referable to *ultimus*.

**Snowy Owl.** *Nyctea scandiaca* (Linnaeus)

Tener observed apparently the same individual four times at Slidre Fiord. All pellets examined contained lemming remains.

**Hornemann Redpoll.** *Acanthis hornemanni hornemanni* (Holboell)

Specimens examined:

Alert area: 1 post-juv. unsexed, 1 juv.

♂, 1 juv. ♀; July 25-August 11, 1951.

Wing measurements of these immature specimens are: 77, 78, and 84 mm. respectively. They are apparently too large, considering their age, to be *exilipes* and thus they appear to be best referable to the nominate race.

Although MacDonald suspected the breeding of this species in the Alert area, he could find no nests. He collected two in juvenal plumage on July 25 that apparently had been flying for some time, and on August 11 he took a specimen in almost complete post-juvenal plumage. He observed the species on April 29 (2); May 25 (2), 31 (1); June 11 (1), 12 (2); July 25 (2); August 11 (4), 12 (1), 13 (6).

**Lapland Longspur.** *Calcarius lapponicus lapponicus* (Linnaeus)

Specimens examined:

Slidre Fiord: 2 juv. ♂; August 5, 1951.

Two males, in juvenal plumage, were collected on August 5 by Tener at Eastwind Lake, near Slidre Fiord. No others were seen and as these birds were in well-developed juvenal plumage and apparently good fliers, they may not have been raised in the immediate area. These appear to constitute the northernmost Canadian record of the species.

**Snow Bunting.** *Plectrophenax nivalis nivalis* (Linnaeus)

Specimens examined:

Slidre Fiord: 5 ad. ♂, 3 ad. ♀; May 9-June 5, 1951.

Alert area: 3 ad. ♂; May 25-31, 1951.

Tener found this the commonest bird on the Fosheim Peninsula. He noted singing individuals first on May 5. On May 24 paired birds were on their territories and males were defending these vigorously. Preferred areas included mud ravines, rocky slopes, ridges, and river banks. A nest on June 25 contained six eggs. First flying juvenals were noted on July 19.

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## CONTRIBUTIONS TO THE FLORA OF NOVA SCOTIA III : SOME INTERESTING WHITE FORMS<sup>1</sup>

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THESE newly or rarely reported white forms of plants from Nova Scotia, were discovered, for the most part, in the course of forest ecology surveys sponsored by the Nova Scotia Research Foundation. These survey parties, during the past four summers, explored areas of the province rarely visited by botanists and therefore had an unusual opportunity for studying frequency of occurrence of colour forms and for gathering information of some value to those interested in variability in flower colour.

The summer party of 1948 was made up of E. C. Smith, D. S. Erskine, E. H. Collins and W. B. Schofield, and their collections are designated by the letters SECS; the collections of the party of 1949, E. C. Smith, E. H. Collins, J. M. Bruce, D. R. Sampson and F. C. Bent are designated by SCBSB; and those of the party of 1951, E. C. Smith, W. B. Schofield, D. R. Sampson and F. C. Bent are designated by SSSB.

SCHIZACHNE PURPURASCENS (Torr.) Swallen forma ALBICANS Fern. Victoria County: in rock crevices and between boulders at river edge, Salmon River, Bay St. Lawrence, SSSB 2657 (and A. E. Roland 1941); rare on dripping cliffs, Big Southwest Brook, SSSB 4542. In both of the above locations the forma *albicans* made up a large percentage of the plants collected. Inverness County: clearing in woods at five hundred feet, north of Cheticamp, W. G. Dore 894.

IRIS VERSICOLOR L. forma MURRAYANA Fern. Only one clone of this white-flowered form has been seen thus far in the province, growing with the typical form. Guysborough County: swale, Auld's Cove, SSSB 4194.

HABENARIA PSYCODES (L.) Spreng. forma ALBIFLORA (Bigel.) Hoffm. Plants intermediate in colour between the typical magenta-flowered and white-flowered plants are frequent but the white form is rare. About twelve of these plants were found growing among many typical individuals. Victoria County: alder swamp near Cape North Village, SSSB 4466.

CALOPOGON PULCHELLUS (Salisb.) R. Br. forma ALBIFLORUS (Britt.) Fern. Guysborough County: wet bog, rare with typical form and pale-flowered intermediates, SECS 630; Richmond County: rare in bog north of Arichat, Isle Madame, growing with intermediates and typical plants, SECS 858. This form was reported previously from only one station in Nova Scotia, the peaty margin of Lake Annis, Yarmouth County, a single plant collected by M. L. Fernald in 1920.

RUBUS STRIGOSUS Michx. forma ALBUS (Fuller) Fern. This white-fruited form was collected by Bell, Bassett, Gorham and Hockey, August 13, 1944 at Cape Split, Kings County.

VICIA CRACCA L. forma ALBIDA (Peterm.) Gams. Colchester County: railway embankment, Truro, R. W. Ward, July 29, 1927.

<sup>1</sup> Received for publication May 28, 1952.

**KALMIA POLIFOLIA** Wang. forma **leucantha** forma nova, forma typicae habita statura etc. similis, floribus omnibus albis. Newfoundland: one plant only in a bog where the typical form was very common, Hodgewater Line, Trinity South, E. C. Smith & A. C. Smith, June 29, 1945. TYPE in Acadia University Herbarium.

This form, though unknown from N.S., appears to be undescribed, and is therefore considered worthy of inclusion.

**CAMPANULA ROTUNDIFOLIA** L. forma **ALBIFLORA** Rand & Redf. The white-form of this species has not been reported from the province before. It is extremely rare, each of the following collections consisting of a single plant. Inverness County: very rare among typical plants on cliff face, Rig-wash Valley, SSSB 4685. Victoria County:

very rare, growing with the typical form, exposed headland, White Point, SSSB 4404.

**LOBELIA KALMII** L. forma **LEUCANTHA** Rouleau. Inverness County: rare, growing with abundant typical plants in alkaline bog, Black River, SSSB 4955. The typical form is rare in the province, having been seen only twice by the authors, once as noted above and in Cape Breton County: wet quaking mat at the edge of a lake, one mile north of McAdam Lake, SSSB 5466.

**SOLIDAGO PUBERULA** Nutt., forma **albiradiata** forma nova, A typica differt radiis albis, haud aureis, radiis. Nova Scotia: dry roadside near Goat Lake, Lunenburg County, J. S. Erskine & D. S. Erskine 845, August 25, 1946. TYPE in Acadia University Herbarium.

## NOTES AND OBSERVATIONS

**Song Sparrows in Central Alberta in Winter.** — The Song Sparrow, *Melospiza melodia*, is normally seen in the Edmonton district from mid-April to late September or early October and has never, to our knowledge, been recorded during the winter months in this region or indeed anywhere in Alberta. The following records of song sparrows near or in Edmonton are therefore of some interest.

On February 23, 1952, the writers were driving slowly along a side road near Spruce Grove some 15 miles west of Edmonton when one of us noticed what appeared to be one of the native sparrows (none of which winter in Central Alberta) hopping about on a brush pile in the wide road-side ditch. We stopped to examine the bird with binoculars and came to the conclusion that it was either a Lincoln's or a Song Sparrow. The bird was collected to establish its identity beyond all doubt and to substantiate the record. It proved to be a male Song Sparrow and showed no signs of past injury which might have prevented it from migrating normally in the preceding fall. It is of course a matter of opinion whether this bird should be considered to have wintered in the district or to have made a very premature spring migration. It was in any case about 500 miles north of the nearest area where others of its species could be found at the date in question. A second Song Sparrow was seen by A. Oeming alone, on December 21, 1952, on the outskirts

of Edmonton. The bird was in good view on the ground and the breast spot was clearly noted through binoculars (in the February bird the breast spot was very indistinct).

It should be noted that while the weather of the winter of 1951-52 was quite average for this district, the present winter has been exceptionally mild up to the end of December, 1952, (time of writing this) and there are already indications that other species of migrants have stayed abnormally late. — E. O. HOHN, *Department of Physiology, University of Alberta*, and A. OEMING, *Edmonton*.

**European Starling on Vancouver Island, B.C.** — On December 21, 1951, two European Starlings (*Sturnus vulgaris* Linnaeus), an adult and bird of the year, were feeding on the lawn in my garden here. They stayed for some minutes. So far as I know this is the first record for Vancouver Island north of Victoria.

It would be interesting to know how these birds reached here, especially in the winter. It is not likely that they arrived in the hold of one of the ships coming from Vancouver, B.C., to coal at Union Bay, some six miles away, as there is no supply of the birds, to draw from, there. The birds did not appear again nor have I heard of any being seen in this district. — THEED PEARSE, *Comox, Vancouver Island, B.C.*

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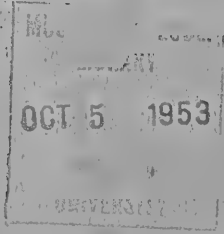
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# The Canadian Field-Naturalist

Vol. 67

OTTAWA, CANADA, JULY-SEPTEMBER, 1953

No. 3

## THE HELVELLACEAE OF THE OTTAWA DISTRICT<sup>1, 2</sup>

J. WALTON GROVES<sup>3</sup> and SHEILA C. HOARE<sup>4</sup>

THE FAMILY Helvellaceae includes a group of large, fleshy Discomycetes in which the fruiting body is differentiated into a fertile, spore-bearing cap of various shapes and a sterile stalk or stipe. The spores are produced within specialized cells or asci which, in this group, are long, cylindric, tapering below to a stalk-like base, and opening at the apex when mature by means of a little lid or operculum through which the spores are forcibly discharged.

Nannfeldt (1937) has suggested that the family is an artificial one in the sense that the various genera included in it do not appear to represent a single evolutionary line of development. It is as if the various lines of development in the Discomycetes were represented by vertical lines and this family were constituted by drawing a horizontal line across them, thus representing a level of development rather than a line of development. However, the species of the operculate Discomycetes are so little known and their relationships so poorly understood, that this is the most practicable basis of classification at our present stage of knowledge.

In the Discomycetes the asci are borne in a definitely organized layer perpendicular to the surface. This fruiting layer or hymenium is not enclosed by other tissue but is exposed to the air. The genera of the Helvellaceae are based principally on the form of the hymenium. Six genera are usually recognized as occurring in North America and, of these, representatives of four have been collected in the Ottawa District. These studies have been based on the specimens preserved in the herbarium of the Division of Botany and Plant Pathology, Science Service, Ottawa, and, whenever possible, on fresh material.

### MORCHELLA

The most important genus in the family is *Morchella* which includes the morels. In this genus the cap is usually more or less cone-shaped or rounded and the surface is pitted in a manner suggesting a sponge. The interior of the pits is lined with the hymenium but the edges are sterile. These fungi are well known to most amateur collectors and are eagerly sought as food since they have, perhaps, the finest flavour of all

### KEY TO THE GENERA

- |   |                    |
|---|--------------------|
| 1. Surface of cap pitted .....  | 2                  |
| 1. Surface of cap even, wrinkled, or ridged but not pitted .....  | 3                  |
| 2. Fruit body with a stem and fertile cap .....   | <i>Morchella</i>   |
| 2. Fruit body lacking a stem and fertile to the base .....  | <i>Daleomyces</i>  |
| 3. Fruit body columnar, furrowed .....  | <i>Underwoodia</i> |
| 3. Fruit body with distinct cap wider than the stem .....   | 4                  |
| 4. Cap bell-shaped, attached to the stem only at the apex .....   | <i>Verpa</i>       |
| 4. Cap saddle-shaped to conical or irregular .....  | 5                  |
| 5. Surface of the cap irregularly contorted and convoluted, colours of the cap<br>in shades of reddish-brown or yellowish-brown ..... | <i>Gyromitra</i>   |
| 5. Surface of cap smooth to slightly uneven, colours of the cap<br>in shades of gray or cream colour to black .....                   | <i>Helvella</i>    |

1 Contribution No. 1170 from the Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa.

2 Received for publication April 22, 1952.

3 Senior Mycologist, Central Laboratory, Ottawa.

4 Assistant Technician, Central Laboratory, Ottawa.

edible fungi. They are easily recognized although care must be taken not to confuse them with the poisonous *Gyromitra esculenta* which has a convoluted rather than pitted cap. The fruiting period of the morels in the

Ottawa District is rather brief, extending through May to early June.

Odell (1926) reported five species of *Morchella* for the Ottawa District, *M. angusticeps* Peck, *M. bispora* Sor., *M. conica* Fr., *M. deliciosa* Fr., and *M. esculenta* Fr., and there are a number of specimens in the herbarium identified as *M. crassipes* (Vent.) Pers. The fungus Odell called *M. bispora* is now considered to be a species of *Verpa* rather than a *Morchella* and is discussed in that genus under *Verpa bohemica*.

*M. esculenta* Fr. (Fig. 1, 2, 3, 4) is the commonest and best known species of the genus and is very variable in size and shape. As a result of field observations by the junior author in the spring of 1949, some doubt arose concerning the validity of the species concepts of *M. deliciosa* and *M. crassipes* and subsequent observations in 1950 and 1951 have confirmed the view that these two species are merely developmental stages of *M. esculenta*.

Overholts (1934) and Seaver (1928) describe *M. deliciosa* as a rather small species with the interior of the pits grayish and much darker than the edges of the ribs which are thick and nearly white. Overholts notes that it appears early in the season and rarely has spores. *M. esculenta* was considered to differ from *M. deliciosa* in the somewhat larger size of the fruit body with the interior of the pits about the same colour as the edges and the edges thinner than in *M. deliciosa*. *M. crassipes* is distinguished by the generally larger size, broad, shallow pits with the edges of the ribs very thin and often torn or lacerated, and the very broad stipe which is usually furrowed and lacunose. It is considered to be a late season species.

Over a period of three seasons, careful observations have been made in the field on a number of fruit bodies. Individual sporophores have been marked in the field and visited periodically for about ten days to two weeks. In addition, fruit bodies have been collected and placed in moist sphagnum in moist chambers in the laboratory and greenhouse and kept under observation until they decayed.

It was noted repeatedly that a fruit body that is typical of *M. deliciosa* with grayish pits having thick, whitish edges, and usually at this stage producing no spores, will, in a few days, become typical *M. esculenta*, and

some days later will have greatly increased in size with the swollen stipe and thin-edged, shallow pits typical of *M. crassipes*. A period of dry weather may arrest this development at one or the other stage and, if prolonged, may cause the fruit body to wither and dry up before reaching the final stage, but under suitable moisture conditions individual fruit bodies go through this complete sequence of development.

Overholts (1934) claimed that the spores of *M. deliciosa* were slightly smaller than those of *M. esculenta*, but he only observed spores under conditions of withering and this might account for the slightly smaller size. Furthermore, there is some evidence that the spores increase slightly in size with the development of the fruit body. For example, a fruit body at Kingsmere, Que. with dark pits and whitish ribs typical of *M. deliciosa* was examined on May 15, 1951, and found to have no spores. On May 18 the spores were well formed although still within the ascus, and measured  $12-16 \times 7.5-9.0 \mu$ . This is almost exactly the size given by Overholts (1934) for *M. deliciosa*. On May 22 the same fruit body had the appearance of *M. esculenta*, approaching a small *M. crassipes*, and many free spores were present measuring  $16-26 \times 10-14 \mu$ . Another fruit body at Kingsmere with the appearance of *M. deliciosa*, on May 18, 1951, had spores measuring  $13-18.5 \times 8-9.5 \mu$ , and on May 22 it had taken on the appearance of *M. esculenta* and the spores measured  $21-24 \times 11-13 \mu$ . Another specimen was collected at Hartwell's Locks, Ottawa, on May 17, 1951, with the appearance of *M. deliciosa*. The spores were still in the asci and, although clearly delineated, were obviously quite immature and measured  $10-14 \times 6-8 \mu$ . The fruit body was placed in moist sphagnum in the greenhouse and on May 19 the spores were  $13.5-17 \times 9-11 \mu$  but still immature. On May 22 they measured  $16.5-20 \times 10-12 \mu$  and were apparently fully mature, but the fruit body had begun to decay and could not be observed further. Other fruit bodies examined showed the same trend of development. It is suggested that the smaller spore size reported for *M. deliciosa* has been based on measurements of immature spores.

*Morchella esculenta* Fr., therefore, may be considered a very variable species with the fruit body varying in height from 5-20 cm. tall or even taller, and the cap more or less ovoid to subglobose, or elongated to conic,

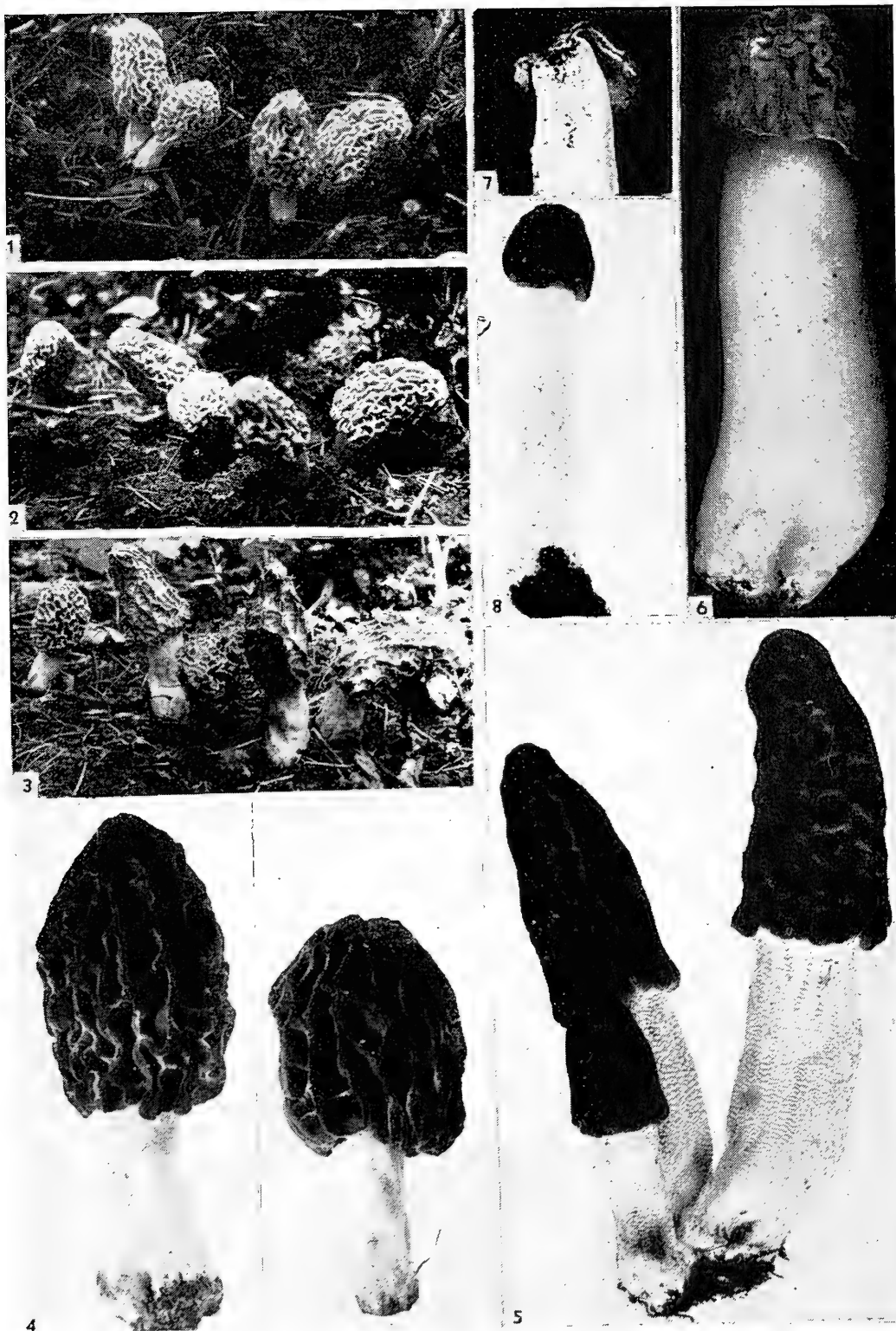


Fig. 1. Cluster of fruit bodies of *Morchella esculenta* photographed at Kingsmere, Que., May 15, 1952. Fig. 2. Same cluster photographed May 18. Fig. 3. Same cluster photographed May 22. Fig. 4. *Morchella esculenta*, two fruit bodies. Fig. 5. *M. angusticeps*. Fig. 6. *Verpa bohemica*, single fruit body. Fig. 7. *V. bohemica*, section showing cap attached at apex of stem. Fig. 8. *V. conica*, single fruit body.

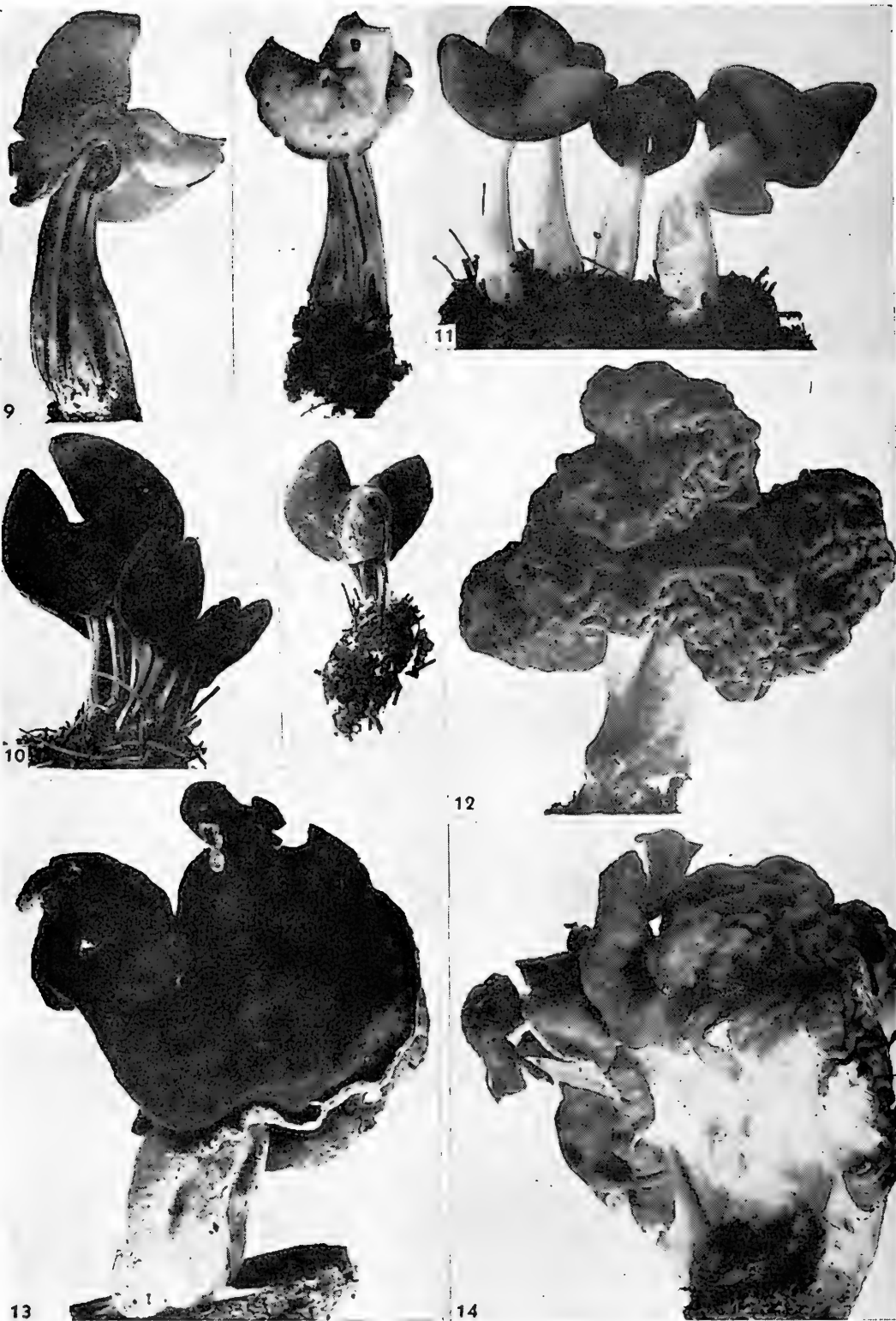


Fig. 9. *Helvella crispa*, two fruit bodies. Fig. 10. *H. lacunosa*, cluster and single fruit body. Fig. 11. *H. elastica*, cluster. Fig. 12. *Gyromitra esculenta*, single fruit body. Fig. 13. *G. infula*, single fruit body. Fig. 14. *G. gigas*, single fruit body.



usually about 2.5-10 cm. long and 1.5-6 cm. broad. The ribs are usually irregularly rather than longitudinally arranged and anastomose to form slightly elongated to isodiametric pits, giving rise to a sponge-like appearance. The pits are at first grayish within, with thick paler to nearly white ribs, then become more open and yellowish-brown with the ribs thinner and concolorous, finally broad and shallow with the ribs becoming very thin and lacerated. The stipe is white to cream colour or yellowish, hollow, at first cylindric usually about 2.5-10 cm. in length and 1-2 cm. in diameter, in age becoming more or less compressed and lacunose, and greatly thickened, up to 6 cm. in diameter at the base, surface glabrous to slightly floccose-mealy. The asci are cylindric, eight-spored, 225-325 x (15)-18-22-(27)  $\mu$ ; the ascospores ellipsoid, one-celled appearing hyaline under the microscope but yellowish in deposits, (12)-16-22-(26) x (7.5)-11-13-(14)  $\mu$ ; paraphyses filiform with the tips swollen to 8-12  $\mu$ .

It is found in open woods, orchards, and grassy places.

In the light of these observations the following species illustrated by Boudier (1905-10) would appear to be indistinguishable from *M. esculenta*:— *M. crassipes* Krombh. (Pl. 194), *M. rotunda* Pers. (Pl. 195), *M. rotunda* var. *fulva* Fr. (Pl. 196), *M. rigida* Krombh. (Pl. 198), *M. ovalis* (Wallr.) Sacc. (Pl. 199), *M. spongiola* Boud. (Pl. 200), *M. vulgaris* Pers. (Pl. 202) and var. *alba* (Pl. 202 bis), and *M. rudis* Boud. (Pl. 203).

*Morchella angusticeps* Peck (Fig. 5) is a distinctive species about 4.5-10 cm. in height with the cap more or less elongated to narrowly conic, occasionally nearly ovoid, usually about 2-6 cm. in length and 1-3 cm. broad at the base, with the ribs more or less longitudinally arranged and 0.5-1.5 mm. in thickness, irregularly anastomosing or connected with cross ribs; the pits vertically elongated, 1-35 mm. long and 1-5 or occasionally up to 11 mm. wide, yellowish or yellowish-brown within, becoming smoky brown to black at the margins and on the edges of the ribs; the stipe is white to yellowish, usually about 2-4 cm. long and 1-2 cm. broad, hollow, cylindric or sometimes broader below, often somewhat furrowed at the base, the surface strongly floccose-mealy; asci cylindric, eight-spored, 200-300 x 16-22-(26)  $\mu$ ; spores ellipsoid, one-celled, appearing hya-

line under the microscope but yellowish in spore deposits, 18-25-(29) x 11-15  $\mu$ ; paraphyses filiform, the tips clavate and swollen up to 6-12  $\mu$ .

It is usually found in open woods or in the edges of woods.

This species can be readily recognized by the longitudinally arranged ribs with black edges, and by the somewhat scurfy stipe.

The concept of *M. conica* Fr. appears to be somewhat confused. Overholts (1934) suggested that it was only a form of *M. esculenta* and the description by Seaver (1928) distinguished it from *M. esculenta* only by the more conic shape of the cap. During the summer of 1950 the senior author had the opportunity of examining the collections of morels at Kew, the British Museum, and in the Persoon Herbarium at Leiden. In these collections it is apparent that no clear-cut concept of the species existed among European collectors. Some of the specimens were simply more or less conic forms of *M. esculenta* and some were apparently identical with *M. angusticeps*, but a good many were collections consisting of a rather small fruit body with a narrow, conic cap and rather definitely longitudinal ribs, and the dried specimens were grayish in colour.

In the herbarium of the Division of Botany and Plant Pathology there is a collection, No. 4535 from Burnet, Que., consisting of five fruit bodies agreeing closely with the European specimens referred to above, but the specimens identified by Odell as *M. conica* are clearly the same as *M. angusticeps*. The fungus figured by Boudier (1905-10) as *M. conica* is apparently indistinguishable from *M. angusticeps*, although the spores are shown as slightly larger.

The elongated, narrow cap and longitudinal ribs of these small specimens in No. 4535 suggested that they might be immature specimens of *M. angusticeps* which, on further development, would become more brown than gray and develop the black edges of the ribs. Insufficient immature material of *M. angusticeps* has been studied to justify any definite conclusions, but on one occasion two small, conical fruit bodies with the edges of the ribs grayish were collected and put in a moist chamber and in a few days the edges of the ribs had turned dark and the fungus took on the appearance of *M. angusticeps*. We are, therefore, of the opinion that these

small, grayish fruit bodies may prove, on further study, to be immature stages of *M. angusticeps*.

This view is supported by Boudier's plates 210 (*M. intermedia* Boud.) and 212 (*M. costata* Vent.), both of which appear to be indistinguishable from *M. angusticeps*, and in both of which he has illustrated, in addition to typical mature fruit bodies, some immature fruit bodies lacking the dark edges to the ribs. The following species illustrated by Boudier (1905-10) all appear to be the same:— *M. conica* Pers. (Pl. 205), *M. angusticeps* Peck (Pl. 206), *M. distans* Fr. (Pl. 207), *M. eximia* Boud. (Pl. 208), *M. intermedia* Boud. (Pl. 210), *M. intermedia* var. *acuta* Boud. (Pl. 211), *M. costata* Vent. (Pl. 212), and *M. elata* Fr. (Pl. 213).

Until the types of these species have been studied it is impossible to be certain whether they are all actually synonyms, or what the correct name of the fungus we are calling *M. angusticeps* should be. If this synonymy proves correct the fungus should be called *M. elata* Fr. since this name was published by Fries (1822) with specific rank, whereas *conica* was only given varietal rank under *M. esculenta*. In the meantime we are not recognizing *M. conica* as a distinct species but are referring all these specimens to *M. angusticeps* Peck.

Another species, *M. semilibera* (DC.) Fr., has been found in New York and Pennsylvania and should occur here but, so far, there is no record of it<sup>5</sup>. It is distinguished by its small size, longitudinally arranged ribs, and the cap only attached about half way down the stem leaving the lower margin free. This species is somewhat intermediate between the genera *Morchella* and *Verpa*.

### VERPA

The genus *Verpa* is characterized by having a bell-shaped cap which is attached only to the upper end of the stalk and hangs down around it with the lower margin free (Fig. 7). The cap is not deeply pitted like a morel although it may be very uneven and prominently ridged. Only two species are known in North America and both have been collected in the Ottawa District.

*Verpa bohemica* (Krombh.) Schröt. (Fig. 6, 7,) is remarkable in that the asci are two-spored, whereas in all the other species of

this family they are eight-spored. The cap is ridged, approaching the genus *Morchella* in gross appearance. It was formerly known as *Morchella bispora* Sor. and, under this name, it was reported and well illustrated by Odell (1920).

The fruit bodies are variable in size, mostly 5-15 cm. tall. The cap is more or less bell-shaped, about 1.5-4 cm. long and 1-3 cm. in diameter, yellowish-brown to reddish-brown, with the surface usually prominently ridged and reticulated. The stipe is whitish to yellowish, glabrous to somewhat floccose, especially toward the base, stuffed, soon becoming hollow, cylindric or somewhat compressed, 3-12 cm. long and 0.5-3 cm. thick. The asci are cylindric, two-spored, about 200-325 x 18-24-(27)  $\mu$ ; ascospores ellipsoid, one-celled hyaline to yellowish, yellowish in deposits, (45)-50-75-(84) x 15-22  $\mu$ ; paraphyses filiform, swollen at the tip to 6-8  $\mu$ .

It is found during May in open woods.

*Verpa conica* (Müll.) Swartz (Fig. 8) can be distinguished by the smaller size, smoother cap, and eight-spored asci. The fruit bodies are about 5-10 cm. tall. The cap is bell-shaped, about 1-2 cm. long and about the same in diameter, olive brown to dark brown, the surface smooth or slightly reticulated. The stipe is whitish to cream colored, slightly floccose or scaly, hollow or very loosely stuffed, cylindric, about 4-8 cm. long and 0.5-1.0 cm. in diameter. The asci are cylindric, eight-spored, 250-350 x 15-23  $\mu$ ; ascospores ellipsoid, one-celled, hyaline to yellowish in deposits, 19-24-(26) x (10.5)-12-14-(16)  $\mu$ ; paraphyses filiform, swollen at the tips up to 9-12  $\mu$ .

It is found in May in open woods.

*V. conica* can be readily distinguished by its generally smaller stature, smaller cap with a smooth surface and olive tinge in the colour. Microscopically it can be recognized at once by its eight-spored asci and the spores which are much smaller than those of *V. bohemica*.

### GYROMITRA

The type species of the genus *Gyromitra* is *G. esculenta* (Pers. ex Fr.) Fr. which was originally described as *Helvella esculenta* Pers. ex. Fr. and was separated later from the genus *Helvella* principally on the basis of the irregularly shaped, much convoluted cap. Kanouse (1948), Smith (1949), and other authors have noted the close relationship between *G. esculenta* and *Helvella infula*

<sup>5</sup> Since the manuscript was submitted, *M. semilibera* has been collected by the junior author at South March, Ont.

Schaeff. ex Fr. and have argued that the convoluted cap was not a difference worthy of generic rank, and that it should be retained in *Helvella*. Seaver (1920, 1928, 1942) has maintained that *G. esculenta* and *H. infula* were not even specifically distinct but that *G. esculenta* was merely a gyrose form of *H. infula*.

Nannfeldt (1932, 1937), on the other hand, has studied a number of species of this group and discussed their relationships, and he was of the opinion that *G. esculenta* and a group of related species, including *Helvella infula*, formed a natural unit and were not closely related to *H. crispa* Scop. ex Fr. and allied forms. As a result of our observations we would agree with this viewpoint and have decided, therefore, to retain *Gyromitra*. As treated here, the genus includes three species found in the Ottawa District, *G. esculenta* (Pers. ex Fr.) Fr., *G. infula* (Schaeff. ex Fr.) Quel., and *G. gigas* (Krombh.) Cke.

***Gyromitra esculenta*** (Fig. 12), sometimes called the False Morel, is the best known species. The fruiting bodies are mostly about 5-12 cm. tall. The caps are very variable in size and shape, irregularly subglobose or rarely conic, to transversely elongated, usually more or less lobed, sometimes depressed on top but not distinctly saddle-shaped, mostly 3-8 cm. broad and 2-6 cm. high, the surface irregularly wrinkled and convoluted but not pitted, yellowish to yellowish-brown, or light to dark reddish-brown, the margin partly free but attached to the stem at various points. The stipe is whitish to pale flesh-coloured, sometimes tinged with grayish-lavender, especially toward the base, glabrous to slightly floccose, stuffed becoming hollow, cylindric to somewhat compressed, sometimes wrinkled or furrowed, usually about 2-5 cm. long and 1-2.5 cm. in diameter. The asci are cylindric, eight-spored, 225-325 x 15-18  $\mu$ ; ascospores (Fig. 15, A) ellipsoid, one-celled, hyaline under the microscope, (17)-20-28 x 11-16-(17)  $\mu$ ; paraphyses filiform, swollen at the tips to 6-9  $\mu$ .

This species is to be found in May or June, growing on the ground in the woods, usually associated with conifers.

Contradictory opinions concerning the edibility of this fungus are to be found in the literature. Undoubtedly many people regularly eat it and suffer no ill effects. Güssow and Odell (1927) stated categorically that it is edible and that they had both

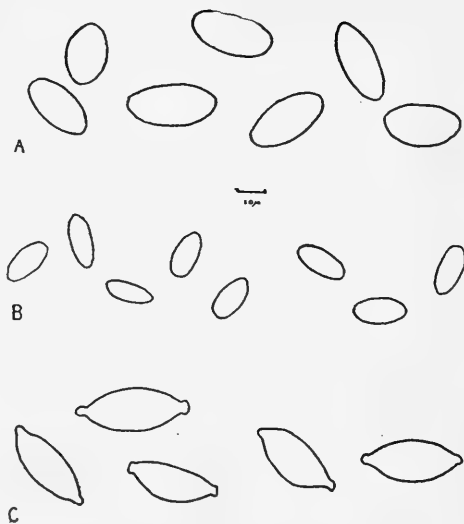


Fig. 15. Drawings of spores of *Gyromitra* spp. A. *G. esculenta*, B. *G. infula*, C. *G. gigas*.

eaten it. Nevertheless there are undoubtedly authentic cases of severe poisoning and even deaths resulting from the use of this species as food, even, in some cases, with people who had habitually eaten it for years. There is some evidence that the poisonous principle may be produced in ageing, aged or over-mature fruit bodies. In the light of the evidence available we are of the opinion that this is an exceedingly dangerous fungus and should on no account be used as food.

***Gyromitra infula*** (Fig. 13) can, in our opinion, be readily distinguished from *G. esculenta*. The fruiting bodies are about 3-10-(15) cm. tall. The cap is typically saddle-shaped, sometimes irregular, mostly 3-8 cm. broad and 2-7 cm. high, the surface usually smooth, sometimes becoming slightly wrinkled to convoluted, usually some shade of tan or brownish-cinnamon, the margin incurved and partly free. The stipe is tinged the colour of the cap, usually paler to whitish, the surface finely floccose, hollow, cylindric to compressed, even or with irregular folds, 2-6 cm. long and 0.5-1.5 cm. in diameter. The asci are cylindric, eight-spored, 225-300 x 10-14  $\mu$ ; the ascospores (Fig. 15, B) ellipsoid, one-celled, hyaline under the microscope, 16-18-(21) x 7-9  $\mu$ ; paraphyses filiform, enlarged at the apex to 7-9  $\mu$ .

This species is to be found in September and October growing in the woods, on or in close association with rotting wood.

The close relationship between *G. esculenta* and *G. infula* has been recognized by all students of the group. As noted above, Seaver (1920, 1928) expressed the view that they were merely forms of the same fungus and placed the names in synonymy. Later (1942) he published some correspondence in which this view was disputed but he maintained his opinion that they were the same.

It is of interest to note that in the Persoon Herbarium at Leiden there is a specimen, No. 910.261.996, labelled *Helvella infula* Schaeff., which had evidently been sent to Persoon by Mougeot and bears the following note "Morille d'automne. Elle croît dans les bois de sapin sur les emplacements de fours à charbon. Notre *Helvella esculenta* est un champignon du printemps tandis que celui-ci croît en automne": This difference in the time of fruiting of the two species has been noted by many other mycologists.

In the correspondence published by Seaver (1942) this point was emphasized by G. S. Bell, but although Seaver agreed that this was a good point, he admitted that he had not checked carefully on the time of occurrence of the species, referring to *G. esculenta*. The senior author has collected both of these species a number of times in different localities over a number of years and this difference in fruiting period has been consistently observed. In one locality at Merivale, southwest of Ottawa, *G. esculenta* has been collected regularly each spring for several years, but no trace of *G. infula* has been found there in the fall although it was searched for.

Kanouse (1948) has summarized the evidence for considering these two fungi to be distinct species. *G. esculenta* grows in the spring on the ground, whereas *G. infula* grows in the summer and fall, either on or closely associated with rotten wood. *G. esculenta* is associated with conifers whereas *G. infula* is associated with deciduous trees. *G. esculenta* is a larger and stouter plant with a very irregular, gyrose cap and stouter stipe, whereas *G. infula* is more slender in stature and has a generally even, saddle-shaped cap. The colours of *G. esculenta* tend toward shades of reddish-brown whereas those of *G. infula* are shades of tan. With all of these points we are in complete agreement except that we do not feel in a position to verify the invariable association of *G. infula* with deciduous trees, although we think this may be true.

The most important point brought out by Kanouse, however, is that there is a pronounced difference in spore size. She examined a wide range of specimens and found that the spores of *G. esculenta* were  $24-28 \times 12-16 \mu$ , whereas those of *G. infula* were  $16-18 \times 7-8 \mu$ . The junior author has made a careful study of all the material in the herbarium of the Division of Botany and Plant Pathology, comprising 23 specimens of *G. esculenta* from Ontario, Quebec, Labrador, Manitoba, British Columbia, Idaho, and Michigan, and 12 specimens of *G. infula* from Ontario, Quebec, British Columbia, and Michigan. She is in complete agreement with Kanouse that these two species can be recognized on the basis of spore size. The ascospores of *G. esculenta* are mostly  $20-28 \times 11-16 \mu$  (Fig. 15, A) and those of *G. infula* are  $16-18 \times 7-9 \mu$  (Fig. 15, B). There may be a slight overlap in the length, especially if slightly immature spores of *G. esculenta* are measured, but the width is a clear-cut diagnostic character. The plates of Boudier (1905-10) also show this difference in spore size.

Seaver (1928) gave the spore size of *G. infula* as  $18-24 \times 8-12 \mu$ , including *G. esculenta* in his species concept. This is an inexplicable dimension that does not apply to either species. It might possibly have been obtained by taking the average of a series of measurements of both species but, if so, it is an illustration of the danger of applying a mathematical concept, such as the average, to biological material and thereby obtaining a figure which is not applicable to either form.

*Gyromitra gigas* (Krombh.) Cke. (Fig. 14) appears to be rare and has not been seen by either of us in fresh condition<sup>6</sup>, but there are two specimens in the herbarium collected by Odell near Graham Bay, Ont. This is a rather large massive species reaching at least 15 cm. in height. The cap is very irregular in shape with the surface folded and convoluted, about 4-12 cm. broad and 4-7 cm. high, smoky brown to reddish-brown, often cracked when dry. The stipe is 3-7 cm. long and 3-5 cm. broad at the base, becoming wider above, irregularly folded and lacunose, whitish to cream colour or tan, hollow. The asci are cylindric, eight-spored,  $315-390 \times 14-19 \mu$ ; ascospores (Fig.

<sup>6</sup> Since the manuscript was submitted, *G. gigas* has been collected by the senior author at Bells Corners, Ont., and by the junior author at Kingsmere, Que.

15, C) ellipsoid to subfusoid with an apiculus at each end, one-celled, smooth, hyaline, (27)-30-39 x 12-14-(15)  $\mu$ ; paraphyses filiform, swollen at the tips to 6-9  $\mu$ .

It is found in spring and early summer on the ground under conifers.

Apparently two species occur in North America that are very similar in appearance, *G. gigas* and *G. caroliniana* (Bosc) Fr. The latter differs in having spores with a rough or sculptured wall. Seaver (1928) did not distinguish between these two. He treated *G. gigas* as a synonym of *G. caroliniana* and described the spores as rough. Kanouse (1948) pointed out this error and described the spores of both species. In the Ottawa collections the spores are smooth and we have no Canadian record of *G. caroliniana*, although it should occur here.

Nannfeldt (1932) has pointed out that the apiculate spores of *G. gigas* are quite unlike those of other *Gyromitra* species and suggest a close relationship to the genus *Discina* in which the apothecia are not stipitate, and usually considered to belong in the *Pezizaceae*. This relationship seems very probable and an improved classification of this group will probably remove *G. gigas* from *Gyromitra* and place it near *Discina*. The genus *Neogyromitra* Imai is available for those who prefer to remove *G. gigas* and *G. caroliniana* from *Gyromitra*.

*Helvella sphaerospora* Peck, which probably also belongs in the *Gyromitra* group, was reported by Odell (1926) but apparently no specimens were preserved. There is no material of this species in the herbarium and neither of us has seen it.

### HELVELLA

The genus *Helvella* is characterized by the more or less saddle-shaped, smooth cap with the colour varying from whitish to gray to nearly black, although *H. elastica* may be somewhat brownish. In general, *Helvella* species are plants of a more slender stature than the *Gyromitras*. The genus is divided into two sections, depending on the stem characters. In one section, including *Helvella crispa* and *H. lacunosa*, the stem is irregular and deeply fluted, whereas in the other section, including *H. elastica*, the stem is cylindric and smooth. The three species above are the only ones reported from the Ottawa District so far.

*Helvella crispa* (Scop.) Fr. (Fig. 9) is considered to be the type of the genus and is the commonest species in this district. The fruiting bodies are about 3-8 cm. tall. The cap is saddle-shaped, irregularly lobed, reflexed, with the margin free from the stipe, whitish to cream coloured, or buff to pale yellowish in age, about 1.5-6 cm. broad, smooth or sometimes slightly convoluted. The stipe is white or coloured like the cap, about 2-6 cm. long and 0.5-2.0 cm. in diameter, very uneven and deeply fluted with longitudinal furrows. The asci are cylindric, eight-spored, 225-300 x 14-18  $\mu$ ; ascospores ellipsoid, one-celled, hyaline, (16)-18-20-(22.5) x 10.0-13.0  $\mu$ ; paraphyses filiform, swollen at the tips to 6-8  $\mu$ .

It is found on the ground in damp woods from August to October.

*Helvella lacunosa* Afz. ex Fr. (Fig. 10) is distinguished from *H. crispa* principally by the dark colour of the hymenium. It is similar in shape and stature to *H. crispa* but the cap is smoky gray to nearly black. The stem is also deeply fluted, usually paler than the cap, but becoming smoky gray. The asci and spores are very similar to those of *H. crispa*.

*Helvella elastica* Bull. ex Fr. (Fig. 11) is easily recognized by the smooth, cylindric stem. The fruiting bodies are 2-10 cm. tall. The cap is irregularly 2- to 3-lobed, usually more or less saddle-shaped, smooth or slightly convoluted, smoky gray, sometimes yellowish to smoky brown or nearly black, 1-3.5 cm. broad, the margin free. The stipe is slender, cylindrical or slightly compressed, not fluted, white to yellowish or smoky, paler than the cap, 3-10 cm. long, 0.3-1.0 cm. in diameter, hollow. The asci and spores in these three species are all very similar.

*Helvella klotzschiana* Corda apparently differs from *H. elastica* only in the size of the stem, which is said to be 1.5 cm. long and 3-4 mm. wide. There are some specimens in the herbarium that could be placed in this species, but all the species of this group are well known to vary considerably in size and shape, and an unusually short stem does not seem to be a character of sufficient importance to justify recognition of a distinct species. More field studies of these small forms are required to see whether or not they do develop further under favourable conditions.

*Helvella atra* Oed. ex Fr. is distinguished from *H. elastica* by the whole plant, including cap and stem, being smoky black in colour. Otherwise it is very similar to *H. elastica* and may be only a colour form. It has not been reported from the Ottawa District but should occur here since there is a specimen in the herbarium from Petawawa.

#### DALEOMYCES AND UNDERWOODIA

The two remaining genera, *Daleomyces* and *Underwoodia*, have only one species in each. They are very rare fungi and seldom collected. Neither of them has yet been found in the Ottawa District although they are known from New York and Michigan and might be expected to occur here.

*Daleomyces phillipsii* (Masse) Seav. has been called the cabbage-head fungus. The fruiting bodies are large, 20-25 cm. in diameter, with numerous, irregular, branching ribs, forming irregular cavities, lined everywhere with the hymenium which is whitish to rosy or pale violaceous. It is well illustrated by Seaver in *Mycologia* 25: pl. 24. 1933.

*Underwoodia columnaris* Peck is a peculiar form with columnar fruiting bodies which are deeply fluted, resembling the stem of *H. crispa* but with the whole surface covered by the hymenium. It has only rarely been collected.

#### CULTURAL STUDIES

Some years ago the senior author, in collaboration with Dr. F. L. Drayton, undertook the study of several species of this family in culture with the aim of studying the sexual behaviour and trying to obtain fruiting bodies in culture. The species cultured were *Morchella angusticeps*, *M. esculenta*, (including what was considered at that time to be *M. deliciosa* and *M. crassipes*), *Verpa bohemica*, and *Gyromitra esculenta*. *G. infula* was later cultured by the junior author.

All of the isolates were very similar in appearance in culture. The spores germinated readily and produced a rather coarse, red-dish-brown, rapidly-growing mycelium which sometimes became aggregated into sclerotium-like masses, but no sexual structures were observed.

The cultures were grown on various media and combinations of media, such as wheat, bran, cornmeal, apple pomace, filter paper,

sawdust, and soil, but all attempts to induce fruiting were unsuccessful.

The cultural characters of the species studied appeared to be of little value in distinguishing between species and the great similarity would suggest that these species were fairly closely related.

#### ACKNOWLEDGEMENTS

The photographs reproduced in Figs. 4, 5, 9, and 11-14 are from the files of the Division of Botany and Plant Pathology, Science Service, and Fig. 10 is reproduced by courtesy of the National Museum of Canada. Every facility was extended to the senior author for examining the specimens in the herbaria at Kew, British Museum, Uppsala, Leiden, and Paris.

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## BIRDS OF THE SAINT ELIAS QUADRANGLE IN THE SOUTHWESTERN YUKON TERRITORY<sup>1</sup>

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THE NOTES for this material were collected in the summer of 1948, from June 1 to September 9, spent in the Yukon Territory in the area of the Alaska Highway between Whitehorse and the Alaska boundary. June was spent in the Shakwak valley between Champagne and Bear creek; July and August were spent in the vicinity of Kluane lake and in the mountains north of that lake. The author was botanical assistant to Dr. Hugh M. Raup, one of the leaders of the party which was locating a late Pleistocene stone culture in area and time. The trip was primarily a botanical and archeological reconnaissance, and birds were studied only as opportunities appeared.

The author is grateful to Dr. Raup for extensive help with the botanical material and to Messrs. James L. Peters and Ludlow Griscom of the Museum of Comparative Zoology at Cambridge, Massachusetts, for help in the preparation of this paper. I would also like to thank W. Earl Godfrey of the National Museum of Canada for very careful and constructive criticisms of the manuscript.

The area lies within the boundaries of the circumboreal needle-leaved forest, but it is modified under this broad heading by its geographical position. It lies within the rain shadow of the Saint Elias range and for this reason has a rainfall of only about ten inches. It is at the southeastern limit of the great interior unglaciated area of Alaska and near the northern end of the Rocky Mountain chain as well as being a northwest limit of prairie vegetation of the Great Plains types. This position gives the area a very varied plant life that shows the following influences: 1) the flora of circumboreal northern forests; 2) the flora of the Great Plains; 3) the varied flora of the unglaciated Alaskan "Refugia", and 4) the vegetation of "Refugia" in the northern Rocky Mountains. For a further discussion of this see H. M. Raup (1946).

The high latitude of the area makes tree-line exist at a relatively low level. As a result there are considerable areas classified

as tundra. It is this high latitude, and therefore cold climate, that preserves the effectiveness of the low rainfall through low evaporation rates, and permits the existence of forests.

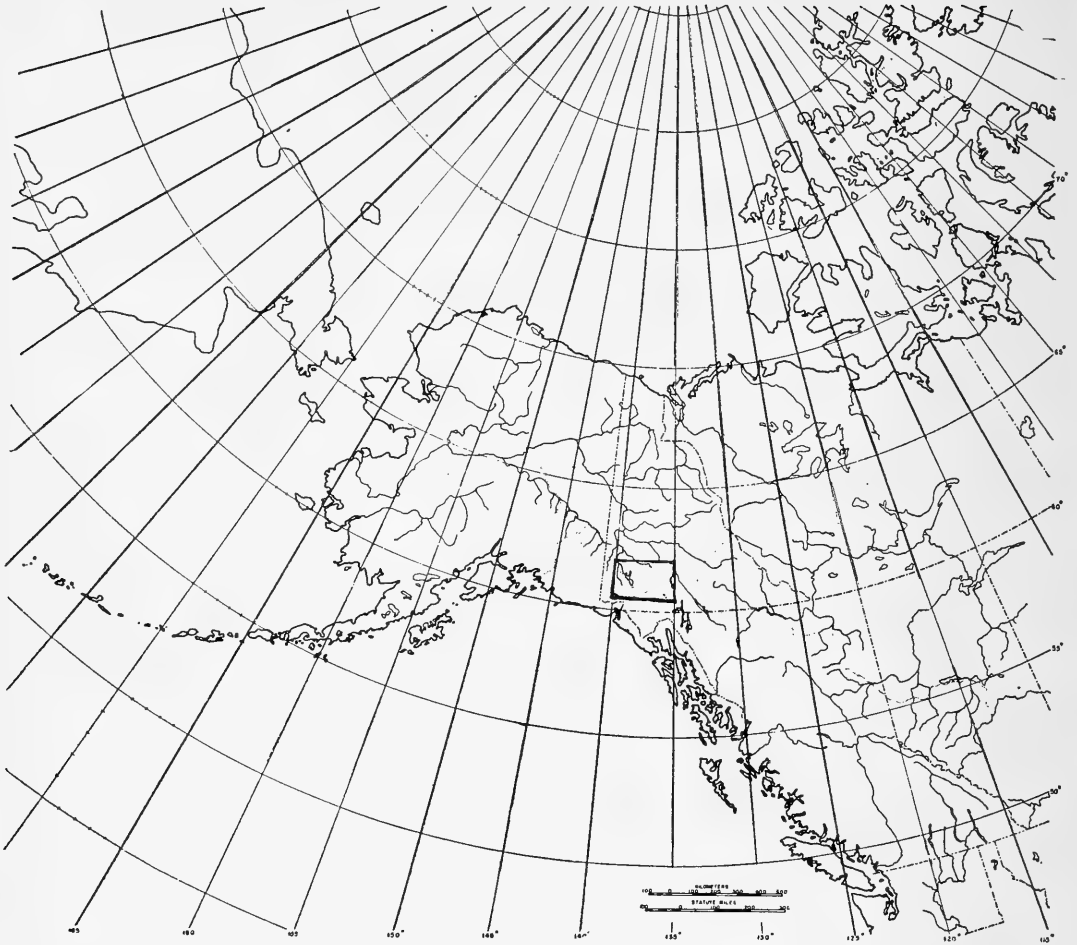
The higher altitudes represent Arctic-Alpine life zones, while the forests of most of the valleys are either Hudsonian or Canadian. Hudsonian Zone is much more widespread, but the presence of ruffed grouse, white birch, aspen and so on indicates that there are Canadian elements.

When A. L. Rand published his "List of Yukon Birds and those of the Canol Road" (1946), his was essentially the first comprehensive list of birds of the Yukon. Previous to the building of the Alcan Highway, this had been a very remote region indeed, but since that time a number of ornithologists have been through the area covered in this paper, viz: Stuart Harris, C. H. D. Clarke, and T. M. Shortt. Reports of their observations are not available. For a very complete list of the activities of all those who have contributed to a list of Yukon birds see Rand's 1946 publication. Before his paper, visits to this southwestern Yukon area had followed water courses, the standard lanes of old-time communication, and nearly all the data are scattered comments by untrained observers. There were, however, L. B. Bishop's report of a U.S. Biological Survey trip down the Yukon in 1899, Elliott Blackwelder's report of a trip from Whitehorse down the Yukon in 1915, and H. S. Swarth's report on a series of trips to the Atlin lake area (southeast of this) from 1924-1934.

Anyone, who has had the opportunity of travelling in the north by waterways and cross-country, will realize how one-sided a picture of the bird-life as well as vegetation is given by travel by water. Mile on mile is travelled through tall forests of white spruce, birch and poplar, and you never see the sloughs, flats, black spruce muskegs, varieties of hillside and plateau forests and solifluction slopes except in glimpses here and there. The overall picture from river travel is an inaccurate idea of healthy, uniform forest.

<sup>1</sup> Received for publication March 8, 1951.





Map of Northwestern North America.

The area where the studies were made is outlined near the centre of this map.

Rand gives a good summary by regions of the most conspicuous birds in the Yukon Territory, quoted below, but it seems he has rather overemphasized the scarcity of birds. Bird populations are low and are variable within the area depending on a series of intangible factors. Either a short visit or a three-months' stay, however, leaves you with a vivid impression that this forest and its bird life are similar to those you find in northern Maine, New Hampshire, Quebec, and New Brunswick. Anyone brought up near northern New England feels he has travelled 4,000 miles to the Yukon and found the same thing he could by travelling 400 at home.

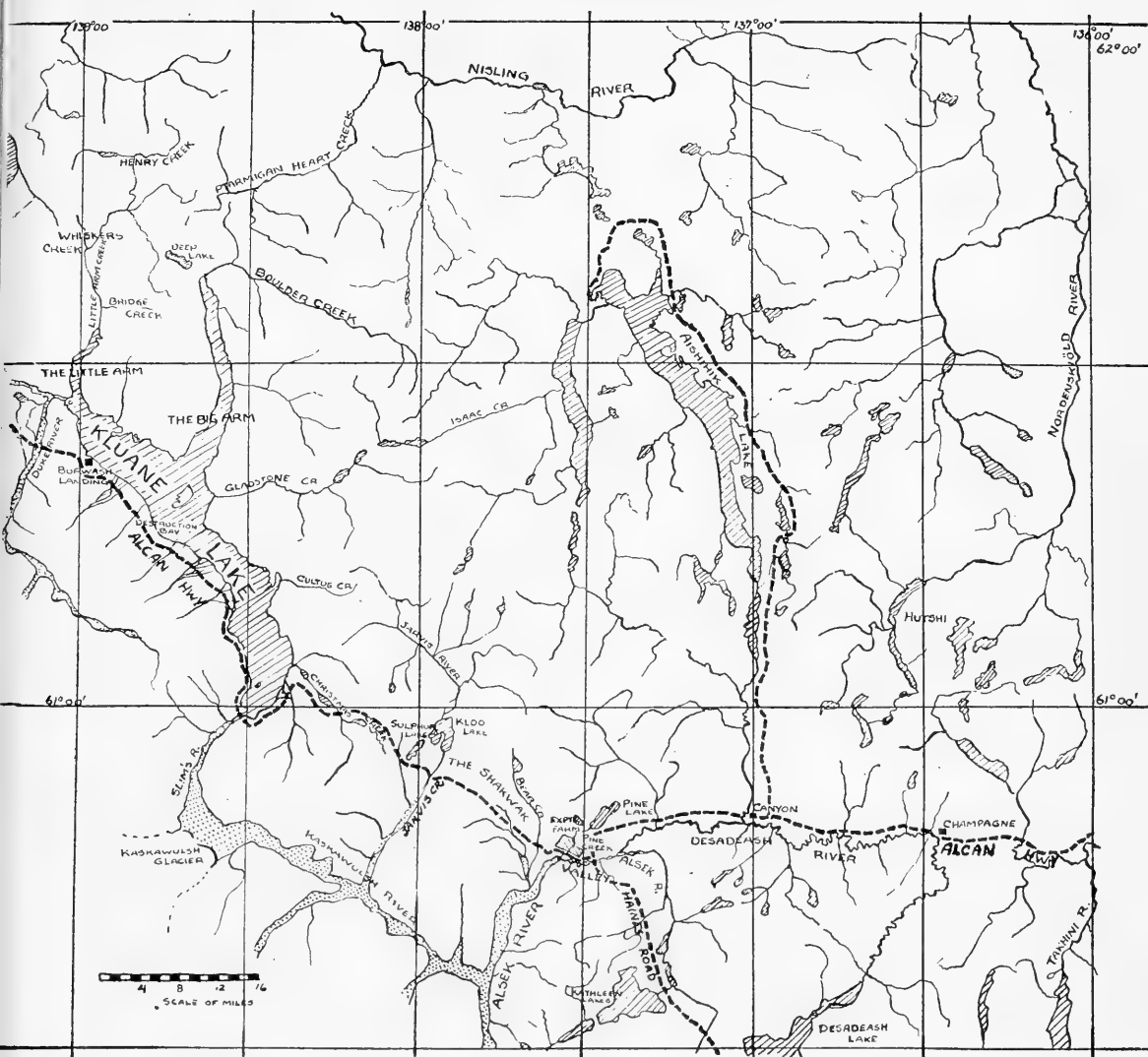
The following quotation is from Rand (1946):

"On the Arctic coast in summer are such birds as arctic and red-throated loons, whistling swans, old-squaw, common rough-legged hawk, willow and rock ptarmigans, little brown crane, golden plover, semipalmated and Baird sandpiper, long-tailed jaeger, glaucous gull, arctic tern, snowy owl, horned lark, pipit, common redpoll, savanna sparrow, Lapland longspur, and snow bunting.

Some of these, such as the ptarmigan, pipit, and horned lark, follow the tundra south on the mountain tops, where in addition a few alpine birds occur, such as white-tailed ptarmigan, wandering tatter, and rosy finch.

At timberline along the Canol Road occur such species as willow ptarmigan, boreal shrike, tree sparrow, and golden-crowned sparrow.

The forests along the Canol Road were characterized by such birds as the following, being at least fairly common and widespread: goshawk, spruce grouse, horned owl, hawk owl, ladder-backed woodpecker, olive-sided flycatcher, brown-headed chickadee, Swainson thrush, ruby-crowned kinglet, Bohemian waxwing, myrtle warbler, and junco.



Map of the southwest corner of the Saint Elias quadrangle.

The map shows the Alaska Highway, the Haine's Road, and localities mentioned in the paper.

For the most part along the Canol Road bird life was scarce in regard to both species and individuals. This, too, was the experience of Bishop (1900, p. 49) who wrote '.... The Yukon Valley seems wanting in bird life — not the center of abundance of its avifauna, but rather a deposit for the overflow from more favoured regions. There are exceptions to this rule, notably wandering flocks of crossbills, the colonies of bank swallows of Fiftymile and Thirtymile rivers and the Yukon proper, the spotted sandpipers that continually flitted across our bow, the intermediate (=white-crowned) sparrows and juncos that seldom failed to greet us as we stepped ashore, and the Alma (=Swainson) thrushes whose songs sounded all night wherever we happened to camp. Bird life is fairly abundant, too, in certain favoured places such as Log Cabin, Caribou Crossing, the swampy

shores of Lake Marsh, and the ponds and level country at the lower end of Lake Laberge.... In the entire Upper Yukon Valley breeding colonies of shore and water birds were conspicuously absent.'

On the Canol Road, too, there were occasional exceptions to this scarcity, as about the marshy lakes in the Pelly River Valley where in the willow and alder thickets were many yellow and orange-crowned warblers, fox and white-crowned sparrows, and alder flycatchers, nearby lesser yellow-legs, short-billed and Bonaparte gulls, and rusty black-birds were common, and on the marshy lakes were many horned grebes, mallard, green-winged teal, pintail, baldpate, shoveller, and lesser scaup."

It seems there may be at least two explanations for these impressions: 1) If you travel the rivers in middle June when the birds

are singing you get the impression of many birds around, but after the first of July, they suddenly become quite silent and you can drift for miles with few signs of bird life where two weeks before there were birds every fifty or hundred yards. 2) The construction of highways follows the solid base of the uplands and in general the white spruce forest rather than marshy areas. It has been the author's impression too, that birds are much less common right next to the highways than they are farther into the forest. The spruce forest is the most sparsely populated of the vegetation types as far as birds are concerned and routes of travel seem to follow this vegetation type. A student of vegetation ranging across all the types he can find and struggling through swamps and flats and pond margins, finds quite a different sample of the bird life. Perhaps in its own way it is less typical, but this is a subjective impression and depends on what percentage of the area you consider to be vegetated by white spruce forest. This does not mean that the birds are abundant, but that their populations seemed to be similar to those of the rest of the boreal forest.

#### Description of the area

A pre-glacial valley runs along the northern flank of the Saint Elias mountain range through what is now the Dezadeash, Shakhwak and Kluane valleys. It is blocked by an esker at Champagne and by till between Bear creek and Kluane village. The present topography in this ancient valley is controlled by: 1) the glacial deposits, now modified by long periods of frost action; 2) the presence of post-glacial lakes; and 3) deposition of wind-blown silts. This deposition of silt is continuing today and there are living Indians whose parents built a cache on the shore of a lake that once covered part of the Dominion Experimental Substation at Pine creek. The pre-glacial valley now exists as a rounded, shallow valley floor 10-15 miles across, occupied on the northwest end by Kluane lake in the southeast by the prairies, aspen groves, and spruce forests on the ancient lake beds of the Dezadeash valley.

On the southwest shore of Kluane lake the forest extends 3-4 miles from the beach to tree-line, and on the northeast shore the spruce extends many miles up the valleys of the creeks that empty into the lake on that side. The lake is at an altitude of 2500 feet and tree-line is at about 3500-4500 feet.

The present creeks and rivers have high terraces lining their courses, indicating the former extent of their channels. On the margins of the terraces in the main valley are areas of prairie vegetation. In the Shakhwak valley, between Pine lake and Bear creek, where the Haines Cut-off leaves the Alaska Highway, there are a number of natural prairie openings. These are in the lower part of the valley floor, below the level of the lake which covered most of the Dominion Experimental Substation. It would seem that these openings, and the aspen groves that are advancing into them, occupy the youngest land surfaces covered by fine-grained, silt soils. On the equally young, coarse gravels of the abandoned channels of glacial streams, a poplar-spruce-willow vegetation appears.

The next older land surface higher than the above lake shore is occupied by an open park-like forest of Porsild's white spruce (*Picea glauca* var. *Porsildii*). This seems to occupy the margins of the main stand of spruce which is Alberta white spruce (*Picea glauca* var. *albertiana*). These two types of forest: the dry open forest of Porsild's spruce and the more familiar dense and moss-floored forest of Alberta spruce cover the main floor of the valley. Porsild's spruce occupies the younger areas and seems to be a pioneer variety for that reason; while, behind it and often mingling with it, the Alberta white spruce occupies the more definitely forested areas. The open park-like forest supports a much richer bird population both in numbers and in species, than does the dense forest.

The same conditions exist in the area around Kluane lake, except that there are no recently exposed lake beds, and therefore the prairie is limited to the margins of terraces and the very recently abandoned river channels. Most of the aspens around Kluane lake are stunted, scattered, and less than twenty years old, although there are a few eighty-year-old trees on the Duke river terraces near Burwash Landing. This may be because aspens are just moving into the area or that there is simply a lack of suitable habitat. Whichever may be the reason, it seems that this lake is on the edge of the distribution of the species.

Most of the area is covered with white spruce forest. This varies from quite open to the familiar dense, dark northern type.

In general, the area studied has no black spruce forest (*Picea mariana*). Colonies do

occur in the valleys north of Kluane Lake and extensive muskegs to the northwest of the area near the Alaskan border. Pine (*Pinus contorta*) also occurs, in small stands in the southeast corner of this area near Champagne.

When the white traders first moved into the country near the end of the last century, they found it was possible to over-winter horses by turning them loose on the natural ranges found on the margins of the terraces and recently abandoned channels of the Duke, Donjek and White rivers. They found, too, that if the forest were burned off, the first stage of the fire succession produced an association of willows (*Salix glauca*, *Bebbiana*, and *arbusculoides*) and grasses (*Calamagrostis purpurascens*, *Poa glauca*, *Poa nemoralis*, *Bromus Pumpellianus*, *Hierochloë odorata*, *Agropyron trachycaulum*, *Agropyron latiglume*, *Festuca altaica*), in which the horses could feed. Large parts of the valleys are occupied by this type of vegetation. They are relatively barren of bird life.

In areas of morainic topography there are numbers of kettle holes, some with and some without ponds or grassy wet meadows. A few water birds visit these, but most stay close to the larger ponds. The birds found in the vegetation of the damp hollows of the kettle holes occur just as freely in the willow muskegs that line the sluggish streams.

North of the arms of Kluane lake the country gradually rises along the streams; then, starting at about 4,000 feet, which is the height of the valley floor at Henry creek, there is a broad zone of quite unstable habitat which is "tree-line". On seemingly sheltered slopes or where, for some reason, there is protection from frost slumping, the tree-line extends up perhaps another 500 feet. Where slumping is most active, tree-line is on the valley floor. In other words, it seems that in this region the contours of the slope (and thus solifluction) governs the presence of a forest, and not that the presence of a forest governs the contours of the slope. The valleys in this area are occupied by spruce forest, aspen groves, heath-willow muskegs, grassy wet meadows, and tussock-tundra muskegs ("nigger-heads" as they are called in the north).

Above tree-line, great expanses are covered by a willow-birch association. There are also tussock-tundra, grass-sedge wet

meadows, and, at the highest levels, an unorganized aggregation of arctic-alpine species.

These large areas above tree-line are moulded by very intensive frost action into gentle slopes and smooth rounded hilltops. However, here and there, ragged rock outcrops of pinnacles of stone or chimney-like piles of blocks stick out and prove beyond question that the tops were not covered by the last ice sheet.

### Vegetation and Bird Life

The birds seem to distribute themselves among nine major vegetation types. In describing these, only the primary species and the most conspicuous secondary species will be mentioned. By primary species is meant those that are most characteristic and prominent when the association is seen from a distance. The secondary species included here are those others that seem to have some significance. The birds listed as characteristic of these types are those you are liable to see during a visit to them. It includes birds that do not nest in that association but feed there or fly over it regularly. This should be kept in mind or else several of the notes below will seem quite misleading. These notes, then, try to indicate what birds will be evident to anyone in a certain vegetation type, no matter what reasons there may be for the bird's presence.

#### A. *Prairie association:*

The primary species vary depending on the locality, but are some combination of two to all of the following:

*Poa glauca* Vahl  
*Calamagrostis purpurascens* R.Br.  
*Hierochloë odorata* (L.) Wahl.  
*Juncus balticus* Willd. var. ?  
*Arctostaphylos uva-ursi* (L.) Spreng. var.  
*coactilis* Fern. and Macbr.  
*Artemisia frigida* Willd.

#### Secondary species:

*Bromus Pumpellianus* Scribn.  
*Agropyron trachycaulum* (Link) Malte  
*Agropyron latiglume* (Scribn. and Smith)  
 Rydb.  
*Agropyron yukonense* Scribn. and Merr.  
*Salix glauca* L., esp. var. *acutifolia* (Anders.) Schneider  
*Salix Bebbiana* Sarg.  
*Cerastium beeringianum* Cham. and Schl.  
*Pulsatilla hirsutissima* Britt.  
*Potentilla nivea* L. vars.  
*Rosa acicularis* Lindl.

*Astragalus frigidus* (L.) Gray var. *americanus* (Hook.) Wats.  
*Oxytropis splendens* Dougl.  
*Hedysarum alpinum* L. ssp. *americanum* (Michx.) Fedtsch. var. *grandiflorum* Rollins  
*Linum Lewisii* Pursh  
*Shepherdia canadensis* (L.) Nutt.  
*Androsace septentrionalis* L.  
*Penstemon procerus* Dougl.  
*Penstemon Gormanii* Greene  
*Solidago decumbens* Greene  
*Antennaria* sp.  
*Achillea Millefolium* L. var.

Very few birds actually occupied this type of vegetation, but nearly all of the occupants of the aspen groves visited it occasionally to feed.

Short-billed gull (*Larus canus brachyrhynchus*), mourning dove (*Zenaidura macroura marginella*) and magpies (*Pica pica hudsonia*) seemed to feed regularly in the prairie openings as, presumably, did the single killdeer (*Charadrius vociferus vociferus*) that was heard at Pine creek. Nighthawks (*Chordeiles minor minor*), violet-green swallows (*Tachycineta thalassina lepida*), bank swallows (*Riparia riparia riparia*) and cliff swallows (*Petrochelidon pyrrhonota hypopolia*) hawked over them commonly, while Say's phoebe (*Sayornis saya saya*) and mountain bluebird (*Sialia currucoides*) occupied the margins of the prairies.

#### B. Aspen grove association:

##### Primary species:

*Populus tremuloides* Michx.

##### Secondary species:

Grasses and others that extend in from the surrounding prairies.

*Populus balsamifera* L.

*Salix myrtillofolia* Anders.

*Salix Bebbiana* Sarg.

*Cerastium beeringianum* Cham. and Schlecht.

*Potentilla Anserina* L.

*Astragalus frigidus* (L.) Gray var. *americanus* (Hook.) Wats.

*Hedysarum Mackenzii* Richardson

*Polemonium pulcherrimum* Hook.

*Mertensia paniculata* (Ait.) G. Don

The groves are found in their clearest form near the Dominion Experimental Substation at Pine creek, where they are just like the "poplar bluffs" of the plains of Alberta. They usually are pure stands of aspen and

are often entirely surrounded by prairie, yet many border on a muskeg or grade into the spruce forest. This association has a surprisingly rich bird fauna.

Yukon ruffed grouse (*Bonasa umbellus yukonensis*)

ring-necked pheasant (*Phasianus colchicus torquatus*)

yellow-shafted flicker (*Colaptes auratus luteus*)

hairy woodpecker (*Dendrocopos villosus septentrionalis*)

eastern phoebe (*Sayornis phoebe*).

western wood pewee (*Contopus richardsonii richardsonii*)

American magpie (*Pica pica hudsonia*)

black-capped chickadee (*Parus atricapillus* subsp.)

Hudsonian chickadee (*Parus hudsonicus columbianus*)

eastern robin (*Turdus migratorius migratorius*)

olive-backed thrush (*Hylocichla ustulata swainsoni*)

hermit thrush (*Hylocichla guttata* subsp.)

Tennessee warbler (*Vermivora peregrina*)

orange-crowned warbler (*Vermivora celata* subsp.)

black-poll warbler (*Dendroica striata*)

myrtle warbler (*Dendroica coronata hoo-veri*)

slated-colored junco (*Junco hyemalis hyemalis*)

chipping sparrow (*Spizella passerina passerina*)

The following birds occurred as visitors to the groves or seemed to feed in the air over them or, because the distribution of aspen forests coincides with old lake beds and thus correlates with present marshes and feeding areas, were so often seen from the groves that the groves constitute a good place to look for them.

sharp-shinned hawk (*Accipiter striatus velox*)

sparrow hawk (*Falco sparverius sparverius*)

short-billed gull (*Larus canus brachyrhynchus*)

nighthawk (*Chordeiles minor minor*)

violet-green swallow (*Tachycineta thalassina lepida*)

cliff swallow (*Petrochelidon pyrrhonota hypopolia*)

Canada jay (*Perisoreus canadensis canadensis*)

raven (*Corvus corax principalis*)  
 blue-headed vireo (*Vireo solitarius* ? *solitarius*)  
 pileolated warbler (*Wilsonia pusilla pileolata*)

C. Open, park-like forest: *Posild's spruce association*

Primary species:

*Picea glauca* Voss var. *Porsildii* Raup  
*Salix glauca* L.  
*Salix glauca* L. var. *acutifolia* (Anders.)  
 Schneider  
*Shepherdia canadensis* (L.) Nutt.  
*Arctostaphylos Uva-ursi* (L.) Spreng. var.  
*coactilis* Fern. and Macbr.

Secondary species:

*Equisetum arvense* L.  
*Picea glauca* Voss var. *albertiana* (S.  
 Brown) Sarg.  
*Festuca rubra* L.  
*Calamagrostis purpurascens* R. Br.  
*Zygadenus elegans* Pursh  
*Populus balsamifera* L.  
*Salix arbusculoides* Anders.  
*Anemone multifida* Poir.  
*Anemone Richardsonii* Hook.  
*Draba* 2 spp.  
*Erysimum* ? *cheiranthoides* L.  
*Arabis* ? *hirsuta* (L.) Scop.  
*Saxifraga tricuspidata* Rottb.  
*Dryas Drummondii* Richards.  
*Dryas integrifolia* Vahl  
*Lupinus arcticus* S. Wats.  
*Astragalus alpinus* L.  
*Oxytropis foliolosa* Hook.  
*Oxytropis gracilis* (A. Nels.) K. Schum.  
*Hedysarum alpinum* L. ssp. *americanum*  
 (Michx.) Fedtsch. var. *grandiflorum*  
 Rollins  
*Pyrola grandiflora* Radius  
*Solidago multiradiata* Ait.  
*Solidago decumbens* Greene  
*Achillea Millefolium* L.  
*Artemisia frigida* Willd.  
*Artemisia borealis* Pall.  
*Arnica alpina* (L.) Olin ? ssp. *angustifolia* (Vahl) Maguire

The breeding birds of this association are:

nighthawk (*Chordeiles minor minor*)  
 western wood pewee (*Contopus richardsonii richardsonii*)  
 Canada jay (*Perisoreus canadensis canadensis*)  
 raven (*Corvus corax principalis*)  
 black-capped chickadee (*Parus atricapillus* subsp.)

Hudsonian chickadee (*Parus hudsonicus columbianus*)  
 red-breasted nuthatch (*Sitta canadensis*)  
 eastern robin (*Turdus migratorius migratorius*)  
 olive-backed thrush (*Hylocichla ustulata swainsoni*)  
 mountain bluebird (*Sialia currucoides*)  
 myrtle warbler (*Dendroica coronata hoo-veri*)  
 pileolated warbler (*Wilsonia pusilla pileolata*)  
 pine siskin (*Spinus pinus pinus*)  
 white-winged crossbill (*Loxia leucoptera leucoptera*)  
 slate-colored junco (*Junco hyemalis hyemalis*)

The presence of birds occupying coniferous and deciduous types of vegetation in this association is explained by the heterogeneous texture of the association as far as the birds are concerned. The large areas between the scattered spruce trees are occupied by tall deciduous willows. This vegetation type often grades into the willow muskeg.

The following birds were seen in this vegetation type, but probably were not breeding in it in the area visited by the author. They bred in neighboring vegetation types or were seen on migration.

sparrow hawk (*Falco sparverius sparverius*)  
 American magpie (*Pica pica hudsonia*)  
 varied thrush (*Ixoreus naevius meruloides*)  
 hermit thrush (*Hylocichla guttata* subsp.)  
 ruby-crowned kinglet (*Regulus calendula calendula*)  
 Bohemian waxwing (*Bombycilla garrula pallidiceps*)  
 purple finch (*Carpodacus purpureus purpureus*)

D. Northern spruce forest: *Alberta spruce association*

Primary species:

*Picea glauca* Voss var. *albertiana* (S.  
 Brown) Sarg.  
*Pleurozium schreberi* Bry. Eu.  
*Hylocomium splendens* (Hedw.) Bry. Eu.

Secondary species:

*Peltigera*, *Cladonia* and *Cetraria* lichens  
 (These are primary in many places.)  
*Festuca rubra* L. var. *arenaria* (Osbeck)  
 Fries  
*Poa glauca* Vahl  
*Kobresia myosuroides* (Vill.) Fiori and  
 Paol.

*Salix glauca* L.  
*Salix glauca* L. var. *acutifolia* (Anders.)  
 Schneider  
*Lupinus arcticus* S. Wats.  
*Astragalus alpinus* L.  
*Hedysarum alpinum* L. ssp. *americanum*  
 (Michx.) Fedtsch. var. *grandiflorum*  
 Rollins  
*Hedysarum Mackenzii* Richards.  
*Shepherdia canadensis* (L.) Nutt.  
*Pyrola grandiflora* Radius  
*Arctostaphylos uva-ursi* (L.) Spreng. var.  
*coactilis* Fern. and Macbr.  
*Arctostaphylos rubra* (Rehd. and Wils.)  
 Fern.

Where the floor of the forest is fairly moist, there is a thicker moss mat and an increase in the numbers of the following species.

May become primary:

*Equisetum scirpoides* Michx.  
*Empetrum nigrum* L.  
*Ledum groenlandicum* Oeder  
*Vaccinium Vitis-Idaea* L. var. *minus* Lodd.

Secondary species:

*Habenaria hyperborea* (L.) R. Br.  
*Geocaulon lividum* (Richards.) Fern.  
*Rosa acicularis* Lindl.  
*Lupinus arcticus* S. Wats.  
*Moneses uniflora* (L.) Gray  
*Pyrola secunda* L.  
*Pyrola grandiflora* Radius  
*Rhododendron lapponicum* (L.) Wahl.  
*Pedicularis labradorica* Wirsing  
*Linnaea borealis* L.  
*Saussurea angustifolia* (Willd.) DC. var.  
*yukonensis* A. E. Porsild

The nesting birds of this association are:

pigeon hawk (*Falco columbarius columbarius*)  
 spruce grouse (*Canachites canadensis osgoodi*)  
 great horned owl (*Bubo virginianus lagophonus*)  
 great gray owl (*Strix nebulosa nebulosa*)  
 hairy woodpecker (*Dendrocopos villosus septentrionalis*)  
 Arctic three-toed woodpecker (*Picoides arcticus*)  
 Alaska three-toed woodpecker (*Picoides tridactylus fasciatus*)  
 western wood pewee (*Contopus richardsonii richardsonii*)  
 Canada jay (*Perisoreus canadensis canadensis*)  
 raven (*Corvus corax principalis*)

black-capped chickadee (*Parus atricapillus* subsp.)  
 Hudsonian chickadee (*Parus hudsonicus columbianus*)  
 eastern robin (*Turdus migratorius migratorius*)  
 Townsend's solitaire (*Myadestes townsendi*) found at high altitudes, near tree-line  
 ruby-crowned kinglet (*Regulus calendula calendula*)  
 myrtle warbler (*Dendroica coronata hooveri*)  
 black-poll warbler (*Dendroica striata*)  
 pine siskin (*Spinus pinus pinus*)  
 white-winged crossbill (*Loxia leucoptera leucoptera*)  
 slate-colored junco (*Junco hyemalis hyemalis*)

#### E. Willow muskeg association:

This association is found at the level of the valley floors.

Primary species:

Tall shrubs of *Salix glauca* L., *S. glauca* L. var. *acutifolia* (Anders.) Schneider, and *S. pulchra* Cham.; these may grow to be twelve feet high.  
*Calamagrostis canadensis* (Michx.) Nutt. var. *scabra* (Presl) Hitchc.  
*Carex capillaris* L.  
*Salix myrtillifolia* Anders.

Secondary species (many of these may be primary in places):

*Festuca rubra* L.  
*Carex Garberi* Fern.  
*Carex aquatilis* Wahl.  
*Tofieldia palustris* Huds.  
*Habenaria hyperborea* (L.) R. Br.  
*Salix reticulata* L.  
*Betula glandulosa* Michx.  
*Potentilla fruticosa* L.  
*Dryas integrifolia* Vahl  
*Arctostaphylos rubra* (Rehd. and Wils.) Fern.  
*Vaccinium uliginosum* L.  
*Vaccinium Vitis-Idaea* L. var. *minus* Lodd.  
*Primula* sp.  
*Pedicularis sudetica* Willd.  
*Valeriana capitata* Pall.

The nesting sparrows of the margins of these shrubby muskegs contribute most of the colour to the morning and evening bird songs. The general impression given by the countryside is usually of them and their songs. The kingfisher, shorebirds and ducks are probably actually attracted to this type



of vegetation by the occurrence in it of sedgy meadows and bodies of water. The swallows occur not in but over the association. Mr. Godfrey tells me he found pileolated warblers nesting in this type of vegetation in this area.

mallard (*Anas platyrhynchos platyrhynchos*)

blue-winged teal (*Anas discors*)

lesser scaup (*Aythya affinis*)

goshawk (*Accipiter gentilis* ? *atricapillus*)

marsh hawk (*Circus cyaneus hudsonius*)

Wilson's snipe (*Capella gallinago delicata*)

spotted sandpiper (*Actitis macularia*)

lesser yellow-legs (*Totanus flavipes*)

kingfisher (*Megaceryle alcyon* ? *caurina*)

alder flycatcher (*Empidonax traillii traillii*)

barn swallow (*Hirundo rustica erythrogaster*)

cliff swallow (*Petrochelidon pyrrhonota hypopolia*)

ruby-crowned kinglet (*Regulus calendula calendula*)

yellow warbler (*Dendroica petechia amnicola*)

myrtle warbler (*Dendroica coronata hoo-veri*)

rusty blackbird (*Euphagus carolinus*)

Savannah sparrow (*Passerculus sandwichensis anthinus*)

tree sparrow (*Spizella arborea ochracea*)

Gambel's white-crowned sparrow (*Zonotrichia leucophrys gambelii*)

fox sparrow (*Passerella iliaca iliaca*)

#### F. Lake and pond margins: aquatic association:

Nearly all of the birds listed here seem to require that a pond have a grassy or marshy margin before they will occupy it. The vegetation is of:

*Equisetum fluviatile* L.

*Calamagrostis canadensis* (Michx.) Nutt.  
var. *scabra* (Presl) Hitchc.

*Eriophorum angustifolium* Honckeney

*Carex aquatilis* Wahl.

*Carex rostrata* Stokes

The pond margins generally are occupied by pure stands of the above species in patches along the shore. The spruce forest may come down to the shore along most of the beach, as long as there is an area of marsh of considerable size. Occupied ponds vary in size from an area of about 1500 square yards up to Kluane lake itself.

common loon (*Gavia immer* subsp.)

horned grebe (*Colymbus auritus*)

mallard (*Anas platyrhynchos platyrhynchos*)

shoveller (*Spatula clypeata*)

canvasback (*Aythya valisineria*)

lesser scaup duck (*Aythya affinis*)

American golden-eye (*Glaucionetta clangula americana*)

Barrow's golden-eye (*Glaucionetta islandica*)

bufflehead (*Glaucionetta albeola*)

white-winged scoter (*Melanitta fusca dixonii*)

ruddy duck (*Erismatura jamaicensis rubida*)

red-breasted merganser (*Mergus serrator*)

bald eagle (*Haliaeetus leucocephalus washingtoniensis*)

spotted sandpiper (*Actitis macularia*)

lesser yellow-legs (*Totanus flavipes*)

herring gull (*Larus argentatus* subsp.)

short-billed gull (*Larus canus brachyrhynchus*)

Bonaparte's gull (*Larus philadelphia*)

arctic tern (*Sterna paradisaea*)

kingfisher (*Megaceryle alcyon* ? *caurina*)

Surf scoter (*Melanitta perspicillata* and semi-palmated plover (*Charadrius hiaticula semipalmatus*) probably nested at Kluane lake, but were not found anywhere else.

#### G. Burned over forest (fire succession):

##### Primary species:

*Poa glauca* Vahl

*Hordeum jubatum* L.

*Calamagrostis purpurascens* R. Br.

*Salix glauca* L.

*Salix glauca* L. var. *acutifolia* (Anders.)

Schneider

*Salix Bebbiana* Sarg.

*Arctostaphylos Uva-ursi* (L.) Spreng. var. *coactilis* Fern. and Macbr.

##### Secondary species:

*Bromus Pumpellianus* Scribn.

*Festuca altaica* Trin.

*Agropyron trachycaulum* (Link) Malte

*Agropyron latiglume* (Scribn. and Smith) Rydb.

*Deschampsia caespitosa* (L.) Beauv.

*Calamagrostis canadensis* (Michx.) Nutt.  
var. *scabra* (Presl) Hitchc.

*Anemone multifida* Poir.

*Pulsatilla hirsutissima* Britt.

*Rosa acicularis* Lindl.

*Lupinus arcticus* S. Wats.

*Astragalus frigidus* (L.) Gray var. *littoralis* Hook.

*Oxytropis gracilis* (A. Nels.) K. Schum.

*Oxytropis splendens* Dougl.  
*Epilobium angustifolium* L.  
*Solidago decumbens* Greene  
*Artemisia frigida* Willd.

The birds of this association include:

Harlan's hawk (*Buteo jamaicensis harlani*)  
 eastern sparrow hawk (*Falco sparverius*  
*sparverius*)

yellow-shafted flicker (*Colaptes auratus*  
*luteus*)

arctic three-toed woodpecker (*Picoides*  
*arcticus*)

Alaska three-toed woodpecker (*Picoides*  
*tridactylus fasciatus*)

Say's phoebe (*Sayornis saya saya*)

western wood pewee (*Contopus richard-*  
*sonii richardsonii*)

raven (*Corvus corax principalis*)

Gambel's white-crowned sparrow (*Zono-*  
*trichia leucophrys gambelii*)

Most of these birds are attracted to this  
 type of vegetation by the standing dead trees.

#### H. Tussock-tundra association:

This is open, grassy-appearing country  
 that is usually found near or above tree-line.  
 Perennially frozen ground is found only a  
 few inches below the surface. For this  
 reason, the ground is very wet in summer  
 even though these meadow-like lands may  
 appear on quite steep slopes. The peren-  
 nially frozen ground is a source of water  
 all summer. There is no primary species for  
 the whole, but there does exist a series in  
 species' abundance, progressing from the wet-  
 test regions to the forest edges or willow-  
 heath type.

Usually, the wettest places are occupied by:

1) *Eriophorum brachyantherum* Trautv.

*Eriophorum angustifolium* Roth

*Carex aquatilis* Wahl.

*Carex rostrata* Stokes

In some areas, very wet localities are occu-  
 pied by:

2) *Eriophorum alpinum* L.

*Scirpus caespitosus* L. ssp. *austriacus*  
 (Pall.) Aschers. and Graebn.

*Carex scirpoidea* Michx.

*Carex lugens* Holm

Then the usual sequence is:

Primary species:

3) *Sphagnum*, *Polytrichum*, *Pleurozium*  
 and *Hylocomium* mosses appear between the  
 tussocks and, with them, the following:

*Betula glandulosa* Michx.

*Ledum palustre* L. var. *decumbens* Ait.

*Vaccinium uliginosum* L.

*Vaccinium Vitis-Idaea* L. var. *minus*  
 Lodd.

then:

4) *Arctagrostis latifolia* (R.Br.) Griseb. var.  
 ? *arundinacea* (Trin.) Griseb.

*Salix reticulata* L.

*Potentilla fruticosa* L.

*Empetrum nigrum* L.

*Ledum groenlandicum* Oeder

*Rhododendron lapponicum* (L.) Wahl.

*Arctostaphylos rubra* (Rehd. and Wils.)  
 Fern.

and

5) *Salix glauca* L.

*Salix glauca* L., var. *Aliceae* Ball

*Salix pulchra* Cham.

Secondary species:

*Equisetum pratense* Ehrh.

*Polygonum viviparum* L.

*Polygonum Bistorta* L. ssp. *plumosum*  
 (Small) Hult.

*Claytonia* sp.

*Saxifraga Hirculus* L.

*Dryas Drummondii* Richards.

*Hedysarum alpinum* L. ssp. *americanum*  
 (Michx.) Fedtsch.

*Pedicularis labradorica* Wirsing

*Pedicularis sudetica* Willd.

*Petasites frigidus* (L.) Fries

*Senecio* ? *yukonensis* A. E. Porsild

*Saussurea angustifolia* DC.

*Saussurea angustifolia* DC. var. *yuko-*  
*nensis* A. E. Porsild

The birds are:

upland plover (*Bartramia longicauda*)

lesser yellow-legs (*Totanus flavipes*)

herring gull (*Larus argentatus* subsp.)

short-billed gull (*Larus canus brachy-*  
*rhynchus*)

Bonaparte's gull (*Larus philadelphia*)

American magpie (*Pica pica hudsonia*)

Savannah sparrow (*Passerculus sand-*  
*wichensis anthinus*)

tree sparrow (*Spizella arborea ochracea*)

Gambel's sparrow (*Zonotrichia leuco-*  
*phrys gambelii*)

Magpies seem to require a combination  
 of the open meadows of the tussocks and  
 the trees on the margins of the openings.  
 Gambel's sparrows live in patches of willow  
 or heath bushes either in the open or along  
 the edges. W. Earl Godfrey tells me he found  
 pileolated warblers in willow and ground  
 birch zones at the edge of tree-line during the  
 breeding season. I missed them.

## I. Willow-heath tundra association:

This is the association that occupies the great areas above tree-line. It covers the gently rounded, green slopes whose topography is probably molded by frost action. Most of it was not covered by glacial ice during the last ice advances.

## Primary species:

*Salix glauca* L. chiefly var. *Aliceae* Ball

*Salix pulchra* Cham.

*Betula glandulosa* Michx.

## Secondary species:

*Festuca altaica* Trin.

*Calamagrostis purpurascens* R.Br.

*Calamagrostis canadensis* (Michx.) Nutt.

var. *scabra* (Presl) Hitchc.

*Carex lugens* Holm

*Tofieldia palustris* Huds.

*Salix reticulata* L.

*Polygonum viviparum* L.

*Polygonum bistorta* L. ssp. *plumosum* (Small) Hult.

*Claytonia* sp.

*Stellaria longipes* Goldie

*Cerastium beeringianum* Cham. and Schl.

*Potentilla fruticosa* L.

*Dryas octopetala* L.

*Astragalus frigidus* (L.) Gray var. *littoralis* Hook.

*Empetrum nigrum* L.

*Epilobium angustifolium* L.

*Epilobium latifolium* L.

*Ledum groenlandicum* Oeder

*Arctostaphylos Uva-ursi* (L.) Spreng. var. *coactilis* Fern. and Macbr.

*Arctostaphylos rubra* (Rehd. and Wils) Fern.

*Vaccinium uliginosum* L.

*Vaccinium vitis-Idaea* L. var. *minus* Lodd.

*Gentiana prostrata* Haenke

*Mertensia paniculata* (Ait.) G. Don

*Castilleja pallida* (L.) Spreng. var.

*Pedicularis labradorica* Wirsing

*Pedicularis sudetica* Willd.

*Valeriana capitata* Pall.

*Artemisia frigida* Willd.

*Artemisia arctica* Lessing

*Petasites frigidus* (L.) Fries

*Arnica alpina* (L.) Olin ssp. ? *attenuata* (Greene) Maguire

*Senecio* ? *frigidus* (Richards.) Less.

*Saussurea angustifolia* DC.

*Saussurea angustifolia* DC. var. *yukonensis* A. E. Porsild

It is inaccurate to speak of primary and secondary species in this association, because the shrubby species take turns in becoming

primary. The real relation is probably one of many species struggling for position in an unstable habitat. Whenever any one gains a foothold, that seems primary there. But the concept is actually meaningless. If that plant loses its position because of some movement of the slope, it may well be succeeded by any one of the other species near it.

## The birds are:

golden eagle (*Aquila chrysaetos canadensis*)

marsh hawk (*Circus cyaneus hudsonius*)

willow ptarmigan (*Lagopus lagopus lagopus*)

upland plover (*Bartramia longicauda*)

Savannah sparrow (*Passerculus sandwichensis anthinus*)

tree sparrow (*Spizella arborea ochracea*)

golden-crowned sparrow (*Zonotrichia coronata*)

The following birds are often seen in this association, but are visitors from the other types.

lesser yellow-legs (*Totanus flavipes*)

herring gull (*Larus argentatus* subsp.)

short-billed gull (*Larus canus brachyrhynchus*)

Bonaparte's gull (*Larus philadelphia*)

Gambel's sparrow (*Zonotrichia leucophrys gambelli*) (visits from near tree-line)

The usual method of describing bird populations is by taking a "sample acreage" on which the bird territories are counted and mapped. This is equivalent to the European method for description of vegetation, the Braun-Blanquet method of plant sociology; or the one that has been used with success in descriptions of prairie associations in the middle west of the United States by plant ecologists of the Clements school. The value of this method depends on the statistical probability that the sample is typical of the whole habitat. It involves making a map of the area and plotting the position of each individual species, and the counting of every plant. In the north, and in most areas not in the prairies, this method has not proven practical because of the variations within plant associations. It is nearly impossible to find any two samples in one area that are identical. Instead, a more subjective method has been used which is the one used in describing the vegetation in this paper. The plants that are most evident, and that characterize the association in the mind of the describer are listed as "primary", and other species, although they may be limited

to the same association, are listed as "secondary". This is necessary because of the lack of regularity in plant groupings, and it seems to the author that the same subjective method of description of bird populations may be the best for this region, for the same reason. The first system claims statistical objectivity but skips over the subjective element in the selection of the sample area. This basic subjectivity certainly is a major factor in the statistics. The second system admits subjectivity throughout.

The following notes are, then, impressions of the most familiar or "characteristic" birds of the various types. They are intended to give the picture of the average area. The numbers should not be considered as specific, but as a general indication of abundance. The purpose of this part of the paper is in part to explain what is meant by the terms "common" or "unusual", of relative abundance that are used in the systematic list of species. In many cases the birds listed together in these plant associations are strange bed-fellows. This part of the paper is written based on vegetation units to describe what birds can be found there; for example: golden eagle and Bonaparte's gull are not nesting species of the willow brush above tree line nor of the aspen groves, but they are seen regularly from these habitats because of the areal distribution of these vegetation types. These distributions are indicated in the geographical description of the area. In a real way this approach is not accurate in accepted ecological usage, but I think it is more realistic than restricting golden eagle and raven to barren rock cliffs and Bonaparte's gull to spruce forest. It would be more accurate to subdivide the classifications according to the type of occupancy, but this seems to me to be unjustifiedly detailed on the basis of the field data I have.

**A. The prairie openings.** These did not have a characteristic bird population as such. There was a pair of magpies for about every four miles of highway through the area of openings and in the same distance you would see none or as many as six short-billed gulls. There was a pair of mountain bluebirds on the borders of each of the six creek terraces that we stopped at between Champagne and Summit. In the evening, the gulls, night-hawks and swallows were very much in evidence flying over or hawking after insects. One pair of violet-green swallows was seen

about every mile along the highway, but cliff and bank swallows were restricted to the neighborhood of creeks. Where found, bank swallows were in flocks of six to thirty, and cliff swallows forty to one hundred and fifty. Say's phoebe was especially common around buildings of all sorts. Nearly every occupied or abandoned highway maintenance camp or small settlement had one or two pairs. The other birds listed within the prairie association were seen once or twice during the summer; thus they have no place in generalizations of populations. Actually the most characteristic birds of the openings were what we heard singing in the surrounding woods: robin, olive-backed thrush, hermit thrush, myrtle warbler, pine siskin, white-winged crossbill and Gambel's sparrow. These species do not belong to the prairie openings, but a person "birding" in these openings would be constantly more aware of them than of the residents of the openings themselves.

**B. The aspen groves.** Ruffed grouse was present in the larger groves of the Pine creek area. In a three hours' walk, you might see as many as three pairs. Flicker was easily the commonest woodpecker. Nearly every burned area and large stand of aspens had a pair. They seemed to be occupying a combination of the two vegetation types, but were especially conspicuous in the burns. Hairy woodpecker was much less common; there were two along fifteen miles of highway near Pine creek. Flycatchers were very uncommon. Magpies were one of the most characteristic birds found where there was a combination of prairie openings and aspen groves, as mentioned above. Either travelling or staying in the same place all day, you would usually see four or five flocks of chickadees, six black-caps and two or three brown-heads. You were constantly conscious of the presence of robins and olive-backed and hermit thrushes during evening and morning. From camp at Pine creek we could hear four robins, four olive-backed thrushes and three hermit thrushes at once. You would hear about this many anywhere in the aspens. Tennessee, orange-crowned and black-poll warblers were seen or heard on the average twice a day at Pine creek, but were very scarce otherwise. There were perhaps three occupied areas of Tennessees and orange-crowns along ten miles of highway there. Myrtle warblers seemed to occupy every aspen grove and junco about every other one. Chipping spar-

row was very scattered and clearly not a primary bird.

**C. Open Porsild's spruce forest.** The following species are the primary ones of this association. During a three hour walk you might see: one nighthawk, two Canada jays, two pairs of black-capped chickadees, one pair of brown-headed chickadees, three robins, three olive-backed thrushes, four myrtle and two pileolated warblers, a flock of ten siskins, a couple of flocks of eight white-winged crossbills and three juncos. Western wood pewees and red-breasted nuthatches were scattered, but could be seen regularly at half a dozen places. Mountain bluebird was regular in its distribution but restricted to combinations of this type of vegetation with open prairies (see under the latter type). Raven, like the other large birds, ranged farther and occupied a greater variety of types. There seemed to be a pair in each of thirteen localities in the hundred miles between Champagne and Burwash Landing. The pileolated warblers occupy the tall willows. W. Earl Godfrey has suggested that the numbers of black-capped chickadees recorded in this type is atypical and I agree completely. I also agree that the black-caps are more characteristic of tall deciduous shrubbery than of spruce woods. The reason for this impression of abundance appears to me to be caused by the character of the open spruce forest in this valley, full of openings with willow shrubs. Marginal areas are very numerous in the region visited and therefore my impression is not accurate beyond the immediate vicinity. This is true too for the appearance of pileolated warbler in this association.

**D. The moss-floored northern spruce forest.** The primary birds were: Canada jay, black-capped chickadee, brown-headed chickadee, robin, myrtle warbler, white-winged crossbill and junco. These species are just about half as common in the moss-floored deep forest as they are in the open Porsild's spruce forest. Spruce grouse is a characteristic bird but spotty in distribution. You can travel many days through the forest without seeing one. Pigeon hawk and the owls were seen only at individual localities, as were the woodpeckers and Townsend's solitaire. Western wood pewee and black-poll warbler were about as common as spruce grouse.

Hawk owls were not seen in the area although Rand (1946) speaks of them as characteristic of the spruce forest of the Canol

Road area and the Indians said they occur regularly here.

**E. Willow muskeg association.** The primary birds seen in an average muskeg about three miles long were: one pair of mallards, four snipe, three spotted sandpipers, three pairs of lesser yellow-legs, five alder flycatchers, four myrtle warblers, five tree sparrows, ten Gambel's sparrows and four fox sparrows. You are reasonably sure of seeing these in every willow muskeg on the valley floors. Teal, goshawks, kinglets and yellow warblers were seen at single localities. Scaup, marsh hawks, swallows and Savannah sparrows were seen in most, but not all of these muskegs. Kingfishers spent a lot of time in these places, but were restricted in distribution to large areas of water.

**F. Lake and pond margins.** Around a lake two miles long you might see one pair each of common loons, scaup, American and Barrow's goldeneyes, two pairs each of bufflehead and spotted sandpipers, three pairs of lesser yellow-legs, one pair each of herring gull, short-billed gull and kingfisher; then five robins and two pairs of rusty blackbirds in the vegetation on the shores. Other species were not uncommon, but were seen on only a few of the many ponds and lakes visited.

**G. Burned areas.** These were very extensive on the south and west shores of Kluane lake. Their primary birds were: Harlan's hawk, sparrow hawk, flicker, and Gambel's sparrow. There were probably a pair of Harlan's and sparrow hawks for every four miles along the highway through the burns; flickers were about as common, while four Gambel's sparrows per mile is a conservative estimate. Occasionally western wood pewee, Say's phoebe, three-toed woodpeckers and ravens were seen.

**H. and I. The meadow-like or tussock-tundra and willow-heath tundra associations.** These can be considered as one unit because the primary birds all range widely across these vegetation types. Shorebirds and gulls were seen perched in low trees or shrubs and the others were frequently seen feeding in the open. The meadow areas near ponds were characterized by lesser yellow-legs, herring gulls, short-billed and Bonaparte's gulls. These meadow areas are usually found in high valleys. A typical meadow of about five acres with a pond would average two pairs of each species. When the meadows were on flat open

hilltops, they usually had none of these, instead Savannah sparrows and upland plovers. There were about four sparrows and one plover seen in two miles of travel. In valleys where the meadows were surrounded by brush and forest, you might see in one mile, four Savannah sparrows, one tree sparrow and three Gambel's sparrows. There seemed to be one family of magpies per valley of this type.

In brush above tree-line, there was about one golden-crowned sparrow per hilltop. One marsh hawk and one group of willow ptarmigan was usual for each mountain visited.

### GEOGRAPHICAL AFFINITIES OF THE BIRD SPECIES

The presentation of the geographical affinities of the birds is to show the similarity of these patterns to those already suggested to exist for plants. That plants and animals in this northwestern region agree quite well in the general areas or patterns of distribution supports an idea presented by Eric Hultén in his "Outline of the History of Arctic and Boreal Biota during the Quaternary Period", 1937. His idea is that there were great areas of refuge or persistence during the last stage of the Pleistocene ice advances. If these areas were populated by plants, certainly they were populated by animals. H. M. Raup discussed the implications of this theory as it applies to the relations of the flora of the southwest Mackenzie region, 1947. He pointed out the source areas for the revegetation of the Mackenzie Mountains after the last ice retreat, and these are suitable sources for the bird population.

It seems advisable to mention briefly the geological concepts that are the basis for these ideas. The various theories on the history of the Pleistocene Glaciation are legion, but there seems to be general agreement on the major outline. At least four major ice advances are recognized between which climate was milder across the north than it is today. These major advances are in turn divided into minor advances between which the climatic conditions were about the same as they are now. As many as fifteen minor advances have been suggested (Sergel and Zeuner).

The main ice sheets advanced from major centers which in North America seem to have been three; in Labrador, in the area west of Hudson Bay, and in the Rocky Mountains. It is not proven that all centers were active at any one time and it is entirely possible

that great areas of the so-called "glaciated regions" were free of ice during major advances. Any area that has ever been covered by any one of the advances is included in the "glaciated area" by geologists, even though during much of the time, it may have been free of ice.

Another assumption that is not proven is that the climate was any considerable amount colder during the major ice advances than it is now. In southern Alaska the largest mountain glaciers in the world run down the south slope of the Saint Elias Range to the sea. On the north slope, towards the interior, the climate is much colder, but no extensive glaciers run into the interior valleys. The reason for this is rainfall, which may be a hundred odd inches on the coast and as little as ten in the rain-shadowed interior. During the periods of ice advance then it is possible that huge areas near the ice supported a healthy forest vegetation. This does not deny the existence of large areas of barren tundra as well, but the point is that forested areas and tundra are not mutually exclusive. On the snouts of many glaciers in the north, healthy coniferous and deciduous forests exist today.

These assumptions are presented to show that there is evidence that will allow nearly limitless possibilities of migrations of plants and areas where they could have existed. Plants that are adapted to arctic environments clearly would feel no pinch during these migrations and changes in climate. They would flourish in the huge areas of tundra. Some species, on the other hand, in their migrations would get trapped in small areas and survive as a small population or become extinct. These areas of survival are called "Refugia" by Hultén.

Where and what were the areas of persistence during the last ice advance? As just mentioned, there must have been large areas where arctic species survived and these species today are the common ones all around the north, the Circumboreal or Holarctic species. There were also refugia of more limited extent but still of large area south of the ice in eastern and western America. These were separated by a dry interior. Other smaller refugia have been suggested for 1) the Newfoundland area, 2) the northwest Pacific coast and islands from British Columbia to the central Gulf of Alaska, 3) the Aleutian Islands, 4) the Bering Sea islands and coasts including Seward Peninsula, 5) the

arctic slope of Alaska north of the Brooks Range, 6) the interior unglaciated plateau of central Alaska, and 7) areas in the northern and central Rocky Mountains. Hultén (1937) discusses the details of how these conclusions were reached for the existence of refugia and their locations. The refugia really need refer only to the last advance, the Wisconsin-three (Mankato) or Würm-three (Pomeranian).

The size of the area of persistence had an important effect on the species that survived there in that it affected species variability. Present understanding in genetics indicates that variability is an ever present factor. In large populations this variation is maintained, but in small populations, because of inbreeding, there is a tendency towards statistical elimination of some variations. This is the Sewall Wright effect. The smaller the population, the stronger is the tendency towards homozygosity. Persistence in refugia during the ice age in small populations isolated from related populations would lead to restriction of variation (such as is found in the northwestern population of American larch) or could affect specific identity. These variations in morphology must be paralleled by variations in physiology and the trend toward homozygosity reduces the ability of the species to adapt itself to different environments. This is probably a genetical explanation for Fernald's "species senescence".

What this means in the history of the re-vegetation of the glaciated regions is that the species occupying the large refugia are aggressive and have spread over most of the north. Those of small areas have not spread far if at all. Most of the species of the boreal needle-leaved forest seem to have existed in large refugia south of the ice and have retained their vigor. Even in these there is clear indication of east-west separation in species of white pine, Banks-lodgepole pine, hemlock, fir, white spruce, larch, aspen and white birch. This same separation exists among bird species. The meeting ground of the two migrant populations seems to lie in the area between Lake Athabasca and the northeast corner of British Columbia.

In a glaciated area like the Mackenzie Mountains, as Raup shows, most of the species are related to an arctic-circumboreal vegetation or to the needle-leaved forests of North America. But there are also a number of species that have migrated into the area from other refugia such as those in the

northern Rocky Mountains, "Beringia" and the Yukon Plateau. The number of these species depends on the size of the refugium and its distance from the area under examination, which takes us back to the vigor of the migration of the species.

The bird species of the southwestern Yukon were examined against this background of plant distributions. The birds were listed according to similarities in ranges and these related areas were found to correspond to vegetational areas. In the course of investigating the ranges, the "Beringia" area was looked at. There are twenty-three species whose breeding range is limited to the area of Seward Peninsula and the delta area of the Yukon and Kuskokwim. These both support Hultén's "Northern Beringia" and point to strong Siberian relationships. Many of these species, like the plants of the area, have not spread far from the shores of the sea. The variety of endemic species on the Aleutian islands supports Hultén's "Southern Beringia" refuge. Because the ranges of birds were tested against previously recognized plant geographical patterns, it must be admitted that the pattern which emerges is biased.

In the Kluane Lake-Shakwak valley region, the bulk of the species is related like the flora to three great geographical groups: 1) the holarctic or circumboreal species found in the forests and tundra around the northern hemisphere, 2) the species of the forests, lakes and swamps of northern North America, and 3) species extending up from the mountain systems of western America. The holarctic species number forty-one, with ten of these the same subspecies all around the north. Sixty-three species extend all across the boreal forest region of North America and of these forty are called the same subspecies. These two groups, then, comprise the populations that were free to move and mix during the ice advances. They are adapted to vegetation types that would seem to have been of general distribution during glaciation. But the influence of the separation of the eastern and western forests is shown in the species, nine, that extend from the eastern forests about to the northeast corner of British Columbia. Of the last geographical group, the Cordilleran species, twelve are subspecific identities and ten are full species clearly differentiated from eastern American species. Two have interesting split distributions, occurring in the Rocky Moun-



tain system and on the northeastern arctic coast, harlequin duck and Barrow's goldeneye. Fernald has discussed plants with similar distributions in his studies of the Newfoundland flora.

Fifteen species have ranges in the Cordilleran system that extend east across the northern Great Plains as far as Manitoba. These perhaps show the eastward extension of biological types from the Rocky Mountains that Raup discussed in his flora of the Athabasca-Great Slave Lake region (1946).

Turning next to the populations that can be pictured as coming from smaller refugia and, therefore, as being less aggressive, the majority of the species listed as North American tundra species (including tundra-nesting Canada geese) occur in the western arctic. This seems to suggest the repopulation of the tundra from the west for them and agrees with the existence of a refugium north of the Brooks Range in Alaska. However, the real evidence from these birds of the north-western interior is for a large, open-forested refugium in interior Alaska. In this area, local subspecies of forest birds could differentiate, such as spruce grouse, ruffed grouse, herring gull, short-billed gull, Canada jay, black-capped chickadee, Alaska chickadee, varied thrush, boreal shrike, myrtle warbler, pine grosbeak, and tree sparrow.

There is strong indication of lack of spreading by the endemic species of the northwest Pacific coast islands. Of the large number of species that are described from that area, perhaps only rusty song sparrow can be thought of as having spread inland. It is hard to guess just what area could be suggested for wandering tatter as it extends from the interior of the Yukon and Prince William Sound to eastern Siberia, but judging from its present nesting sites, it should have found no lack of ideal country during the ice advances.

In the lists, it will be noticed that certain species appear twice, for example species occurring across the northern forests with a subspecies in the Cordilleran region are included as showing relations to both; Cordilleran species with local subspecies in the north also show relations to two areas. These are larger patterns of relationships that, perhaps, can point out the status of the larger species complexes before they were split by latest climatic changes of the Pleistocene. The presence of all of these species groups;

the circumboreal, those with relationships to eastern Canada, those with relationship to the species of the mountain systems and the local Alaskan endemics seem to indicate that the area of this paper is one occupied by migrations from a series of persistent populations and is a collecting and mixing ground of related forms. It also agrees with the botanical observation that species of the Cordilleran area are less vigorous in their expansions to the northeast. Rather, it seems that "Refugia" or persistence areas of the East (probably south of the glacial boundary) were larger and the populations of these more varied and therefore vigorous and capable of spreading into a new habitat.

It would be unprofitable to draw far-reaching conclusions from these geographical relationships, but they do indicate correlations with patterns pointed out in the studies of geographical botany that should not be mere coincidence. Birds are well recognized to adjust themselves remarkably to vegetation types, and certainly, then, these patterns are no surprise. They merely indicate that the correlations exist as historical patterns as well as present-day observations.

**Lists of species by their geographic relationships, including species recorded by Rand (1948) but not seen by this author.**

#### CIRCUMBOREAL SPECIES

(\* — indicates the same subspecies)

- black-throated (arctic) loon
- \* red-throated loon
- Holboell's red-necked grebe
- \* horned grebe
- \* common mallard (subspecies in Greenland)
- pintail
- shoveller
- greater scaup
- American golden-eye
- old-squaw
- white-winged scoter
- \* red-breasted merganser (subspecies in Greenland)
- eastern goshawk
- American rough-legged hawk
- American golden eagle
- American marsh hawk
- American osprey
- American duck hawk
- \* gyrfalcon
- \* (black-shafted) willow ptarmigan
- southern rock ptarmigan
- semi-palmated ringed plover
- \* northern phalarope

herring gull  
 mew gull  
 \* arctic tern  
 American hawk owl  
 great grey owl  
 \* northern short-eared owl  
 Richardson's owl  
 horned lark  
 \* common bank swallow  
 American barn swallow  
 American black-billed magpie  
 North American raven  
 wheatear  
 eastern American pipit  
 American Bohemian waxwing  
 boreal shrike  
 common redpoll  
 red crossbill

### BOREAL NORTH AMERICAN FORESTS AND SWAMPS

(\* — indicates the same subspecies)

\* common loon  
 Canada goose  
 \* blue-winged teal  
 \* green-winged teal  
 \* bufflehead  
 \* northern sharp-shinned hawk  
 red-tailed hawk  
 \* northern bald eagle  
 eastern pigeon hawk  
 \* eastern sparrow hawk  
 spruce grouse  
 ruffed grouse  
 \* northern killdeer plover  
 \* upland plover  
 \* lesser yellow-legs  
 eastern solitary sandpiper  
 \* spotted sandpiper  
 \* Wilson's snipe  
 mourning dove  
 horned owl  
 \* eastern nighthawk  
 \* eastern belted kingfisher  
 \* northern yellow-shafted flicker  
 \* northern hairy woodpecker  
 \* arctic three-toed woodpecker  
 American three-toed woodpecker  
 \* eastern phoebe  
 \* Traill's alder flycatcher  
 \* olive-sided flycatcher  
 \* tree swallow  
 greater cliff swallow  
 \* purple martin  
 eastern Canada jay  
 black-capped chickadee  
 brown-headed chickadee  
 \* red-breasted nuthatch

\* eastern American robin (subspecies in  
 Ungava-Newfoundland)  
 \* hermit thrush  
 \* olive-backed Swainson's thrush  
 \* northern grey-cheeked thrush  
 \* eastern ruby-crowned kinglet  
 \* blue-headed vireo  
 \* Tennessee warbler  
 \* northern yellow warbler  
 myrtle warbler  
 \* black-poll warbler  
 black-capped warbler  
 northern water-thrush  
 yellow-throat  
 \* rusty blackbird  
 purple finch  
 pine grosbeak  
 \* northern pine siskin  
 \* northern white-winged crossbill  
 Savannah sparrow  
 \* eastern slate-colored junco  
 \* eastern chipping sparrow  
 tree sparrow  
 white-crowned sparrow  
 \* white-throated sparrow  
 \* eastern fox sparrow  
 \* northern Lincoln's sparrow  
 song sparrow

### SUBSPECIES FROM THE EASTERN FORESTS TO ABOUT THE NORTHEAST CORNER OF BRITISH COLUMBIA

(From this list are eliminated such species that are very much subdivided into subspecies east of this point, such as ruffed grouse, horned owl, horned lark, black-capped chickadee, and yellow-throat.)

Canada goose (?)  
 eastern pigeon hawk  
 eastern solitary sandpiper  
 eastern Canada jay  
 myrtle warbler  
 black-capped warbler  
 pine grosbeak  
 tree sparrow  
 white-throated sparrow

### CORDILLERAN SPECIES

Species:

blue grouse  
 white-tailed ptarmigan  
 rufous hummingbird  
 northern violet-green swallow  
 northern American dipper  
 varied thrush  
 Townsend's solitaire  
 Townsend's warbler  
 grey-crowned rosy finch

golden-crowned sparrow

Subspecies:

Harlan's hawk

western pigeon hawk

western solitary sandpiper

northwestern horned owl

western belted kingfisher

Alaska three-toed woodpecker

pallid horned lark

Columbian brown-headed chickadee

Rocky Mountain orange-crowned warbler

northern pileolated warbler

Bendire's red crossbill

Cassiar slate-colored junco

## ROCKY MOUNTAIN AND NORTHEAST ARCTIC COAST

Barrow's goldeneye

Harlequin duck (different subspecies)

## CORDILLERAN, NORTHWEST GREAT PLAINS AND WESTERN CANADIAN SHIELD

lesser loon (?)

baldpate

canvas-back

lesser scaup (not cordilleran)

ruddy duck

Alaskan sharp-tailed grouse (not cordilleran)

Bonaparte's gull

western mourning dove

Say's phoebe

western wood pewee

American magpie

mountain bluebird

Bohemian waxwing

Northwestern shrike

orange-crowned warbler

Grinnell's northern waterthrush

Gambel's white-crowned sparrow

## LOCAL SUBSPECIES IN ALASKA AND YUKON

Alaska spruce grouse

Yukon ruffed grouse

Alaska willow ptarmigan (if a good subspecies)

Kenai white-tailed ptarmigan

long-billed dowitcher

short-billed gull

Alaska jay

Yukon black-capped chickadee

Alaska chickadee

northern varied thrush

Alaska hermit thrush

Alaska myrtle warbler

Alaska pine grosbeak

western tree sparrow

kodiak Savannah sparrow

## WESTERN ARCTIC TUNDRA

Pacific loon

whistling swan

lesser Canada goose

western white-winged scoter (if a good subspecies)

eastern golden plover

pectoral sandpiper

## NORTH AMERICAN TUNDRA

surf scoter

Kellogg's rock ptarmigan

little brown sandhill crane

least sandpiper

semipalmated sandpiper

## ANNOTATED LIST OF SPECIES

The assignment to subspecies follows the conclusions of A. L. Rand (*Nat. Mus. of Canada, Bulletin No. 105, 1946*). An attempt has been made to include the latest changes in nomenclature.

**Common Loon** [*Gavia immer* subsp.] nested on the larger lakes and ponds. They were seen on Pine lake, Sulphur lake, Kluane lake and flying overland as if they trade between lakes frequently.

**Pacific Loon** [*Gavia arctica pacifica* (Lawrence)]. About four birds were seen in late July and August on Kluane lake.

**Holboell's Grebe** [*Colymbus grisegena holbölli* (Reinhardt)]. Three birds in fall plumage were seen in Kluane lake, August 26.

**Horned Grebe** [*Colymbus auritus* Linnaeus]. Six or eight birds were seen in breeding plumage on Kluane lake, in August.

**Whistling Swan** [*Cygnus columbianus* (Ord)]. Three, then one, were seen flying over Pine creek in June. According to Rand (1946), on the basis of locality and time, these might have been trumpeter swans [*Cygnus buccinator* Richardson]. The Indians say that swans are common in the fall, but they had not migrated through when we left in early September. These would be whistling swans.

**Lesser Canada Goose** [*Branta canadensis leucopareia* (Brandt)]. The status of this species complex is still doubtful. Geese were very common in late August. They were seen especially on the grassy (*Deschampsia*

*caespitosa*) shores of lakes and were often heard flying over at night. Six were seen July 1.

**Mallard** [*Anas platyrhynchos platyrhynchos* Linnaeus] was fairly common in the shallow, meadowy sloughs and streams in the low altitude muskegs (*Calamagrostis canadensis*-*Carex* types). They were also seen on grassy lake-margins (*Deschampsia caespitosa* type).

**Blue-winged Teal** [*Anas discors* Linnaeus] nested at Whiskers creek.

**Green-winged Teal** [*Anas carolinensis* Gmelin] nested in the grassy margins of streams north of Kluane lake. They were common in migration in August on the grassy shores of lakes where they fed in areas of *Deschampsia caespitosa* flooded by the rise of the lakes.

**American Pintail** [*Anas acuta tztizihoa* Vieillot] was common on the grassy shores of Kluane and the smaller lakes (*Deschampsia caespitosa* type).

**Shoveller** [*Spatula clypeata* (Linnaeus)] bred on Pine lake and Sulphur lake, and occurred on migration on Kluane lake. They were not as common as the above.

**Canvas-back** [*Aythya valisineria* Wilson]. Four pairs were seen in late June on Sulphur lake.

**Greater Scaup Duck** [*Aythya marila ne-arctica* Stejneger]. Flocks of from fifty to one hundred were seen on migration in August on the small ponds just north of Kluane lake. Some few were feeding in stands of *Carex aquatilis*, but most were out in the center of the ponds. They all seemed to be feeding on *Potamogeton* or algae.

**Lesser Scaup Duck** [*Aythya affinis* (Eyton)] nested at Pine lake, Sulphur lake, in muskegs (along Jarvis creek), and in many grassy sloughs (along Little-arm creek and Whiskers creek). They were common during migration on Kluane lake, but in smaller flocks than greater scaup.

**American Golden-eye** [*Bucephala clangula americana* (Bonaparte)] probably nested at Pine lake, Sulphur lake, Kluane lake and along Little-arm creek. Rand (1950) says the summer and breeding status in the Yukon is unknown.

**Barrow's Golden-eye** [*Bucephala islandica* (Gmelin)]. This was actually the commoner species of golden-eye. They seemed to be nesting on Pine lake, Sulphur lake and the

small ponds near Kluane lake. They were seen along Little-arm creek, near Whiskers creek, Ptarmigan Heart and Deep lake. On August 23, after there had already been a three inch snow-fall on the lake shore, two 3-to-4-weeks-old young were seen with their mother. As a young boy had shot them, it was possible to be sure of the identity. The mother had nested by a pond whose margin was covered with spruce woods, willow-birch muskeg and *Calamagrostis canadensis* meadow.

**Buffle-head** [*Bucephala albeola* (Linnaeus)] was common on Pine lake, Sulphur lake, Kluane lake, the small ponds just north of Kluane lake and several small lakes and ponds near Redtail lake and Ptarmigan Heart. A hunter killed two young, still unable to fly, on August 24.

**Harlequin Duck** [*Histrionicus histrionicus pacificus* Brooks]. A pair was seen on the Rancheria river on May 23. This is near Watson lake, and does not belong in this quadrangle.

**White-winged Scoter** [*Melanitta fusca* subsp.]. About ten were seen on Sulphur lake in June and twenty on Kluane lake in late August.

**Surf Scoter** [*Melanitta perspicillata* (Linnaeus)]. Twenty were seen on Kluane lake in early July. They were common in small flocks on Kluane lake in August.

**(Ruddy Duck** [*Oxyura jamaicensis rubida* (Wilson)] was seen on a grassy slough near Sulphur lake in late June. This species has not previously been reported from the area according to Rand's list (1946) or those previous lists he summarizes. A single adult male bird in rather poor plumage was seen once on the only visit in this area. The bird had the black cap and white cheeks of full male plumage, but its body was splotted with chestnut and gray-brown. It was seen clearly, in good light, at about 60 yards with eight power binoculars.)

**Red-breasted Merganser** [*Mergus serrator* Linnaeus] was seen on Pine lake in June and was common on Kluane lake in August. Some ten 2-to-3-day-old young were seen on Kluane lake on August 10. These were still unable to fly on August 26.

**Goshawk** [*Accipiter gentilis atricapillus* (Wilson)] was seen in a black spruce muskeg near Snag in early September.

**Sharp-shinned Hawk** [*Accipiter striatus velox* (Wilson)] was seen flying over aspen

or poplar groves at Pine creek in June, Bridge creek in July and Burwash Landing on August 27.

**Harlan's Hawk** [*Buteo jamaicensis harlani* (Audubon)] was not seen in the Pine creek region, but was very common in the burned areas near Kluane lake. There were at least ten individuals along the southwestern side of the lake in a distance of twenty miles. One was seen at Bridge creek.

**Golden Eagle** [*Aquila chrysaetos canadensis* (Linnaeus)]. There were at least two birds in the region between Bear creek and Jarvis creek. Another was seen over Deep lake.

**Northern Bald Eagle** [*Haliaeetus leucocephalus washingtoniensis* (Audubon)]. These eagles were seen near Mile 95 on the Haines Road, at Christmas creek, at Burwash creek, at Burwash Landing, four between Bridge creek and Whiskers creek, near Ptarmigan Heart and near Deep lake. This species seemed to keep near timbered country, while golden eagles seemed to be above tree-line.

**Marsh Hawk** [*Circus cyaneus hudsonius* (Linnaeus)] was seen over open country, willow-heath muskeg, near Pine creek, Bridge creek, near Burwash Landing and occasionally above tree-line.

**Gyr Falcon** [*Falco rusticolus obsoletus* Gmelin]. One grey-phase individual was seen in late August: first chasing a raven, then sitting on the beach, and finally circling and hawking over the lake near Burwash Landing. The falcon was noticeably larger than the raven, but the latter seemed to be a better flyer. This species is not included in Rand's list (1946).

**Pigeon Hawk** [*Falco columbarius* ? *columbarius* Linnaeus]. Rand (1946) calls Yukon specimens *F. c. columbarius*, the eastern subspecies, but J. L. Peters (1927) calls them *bendirei*. These birds were seen at Champagne and Bridge creek in spruce forests.

**Eastern Sparrow Hawk** [*Falco sparverius sparverius* Linnaeus] was common throughout, especially on the edges of open places and in burned areas.

**Alaska Spruce Grouse** [*Canachites canadensis osgoodi* Bishop] were fairly common in deep spruce woods in the Dezadeash and Kluane valleys. A pair was seen at Henry creek.

**Yukon Ruffed Grouse** [*Bonasa umbellus yukonensis* Grinnell] were seen in the aspen and poplar groves near Pine creek.

**Black-shafted Willow Ptarmigan** [*Lagopus lagopus lagopus* (Linnaeus)]. Rand follows Peters (1934, Check list of Birds of the World, Vol. 2, p. 30) in calling these the typical subspecies. Ptarmigan were common everywhere above tree-line. Probably *Lagopus mutus rupestris* (Gmelin) was present in the regions we visited, but the only birds definitely identified (two) were willow ptarmigan.

**Ring-necked Pheasant** [*Phasianus colchicus torquatus* Gmelin] was heard near the Dominion Experimental Substation at Pine creek, in June.

**Little Brown Crane** [*Grus canadensis canadensis* (Linnaeus)]. The Indians said this bird is very common on migration near Kluane lake, but they had not come by the first week of September.

**Semi-palmated Plover** [*Charadrius hiaticula semipalmatus* Bonaparte]. A pair was seen on the gravel and mud shores of the lake near Burwash Landing on July 1. They behaved as though there were a nest near. A few were seen in August on migration.

**Killdeer** [*Charadrius vociferus vociferus* Linnaeus] was heard in the prairie openings near Pine creek in June. Killdeer are rare stragglers in this area. Rand (1946) includes one sight record and Bailey (1948) two collections from Point Barrow, Alaska.

**Golden Plover** [*Pluvialis dominica dominica* (Müller)] was seen singly or in groups up to eight on Kluane lake in August.

**Wilson's Snipe** [*Capella gallinago delicata* (Ord)] was seen and their song and chatter heard in willow muskegs near Pine creek in June. A few were seen on migration in August near Kluane lake.

**Upland Plover** [*Bartramia longicauda* (Bechstein)] was found quite commonly near grassy meadows or sloping bogs of *Eriophorum brachyantherum* in the willow-heath scrub country. At least twenty-two pairs were seen north of Kluane lake in July. They were still flying over the shores of Kluane lake during the first week of September when their nesting areas had been covered with snow for two weeks.

**Spotted Sandpiper** [*Actitis macularia* (Linnaeus)] was common along all lake-shores and most streams below timber-line. They were not seen in the first week of September.

**Solitary Sandpiper** [*Tringa solitaria* subsp.]. Probably both eastern and western subspecies occur in this area. Two were

seen and heard in a migrating flock of lesser yellow-legs on July 22 at Boulder creek. According to Conover, 1944, *T. s. cinnamomea* breeds to the north of this area and Mr. Godfrey tells me that the three June and July specimens he took in this area were all undoubtedly closer to *solitaria*. Because my birds were clearly migrating, it would be dangerous to assign them to subspecies.

**Lesser Yellow-legs** [*Totanus flavipes* (Gmelin)] nested in grassy sloughs near Pine lake, above tree-line near Mile 85 on the Haines road, near Kluane lake, Bridge creek and Boulder creek. They were still present around the lake during the first week in September.

**Pectoral Sandpiper** [*Erolia melanotos* (Vieillot)]. Six were seen near Burwash Landing on August 27.

**Semipalmated Sandpiper** [*Ereunetes pusillus* (Linnaeus)] was seen during the first week of July and again in August on the shore of Kluane lake. They were not seen well enough to make absolutely sure they were not western sandpipers [*Ereunetes mauri*]. Rand (1946) lists only the present species.

**Northern Phalarope** [*Lobipes lobatus* (Linnaeus)]. Flocks of from a dozen to about fifty were seen on Kluane lake from August 10 until the first week of September.

**Herring Gull** [*Larus argentatus* subsp.]. The breeding herring gulls of all this region seemed to differ from subspecies recognized at present, in the color of their wing-tips. They may be an undescribed race. On two occasions gulls were examined from less than fifty feet with 8 x 40 binoculars in perfect light. The "black" on the tips of the primaries was actually a slatey color, not the familiar color found in eastern birds. This slatey region was restricted to a margin around the wing-tip. When one bird stretched its wings, it showed clearly that the tenth (outermost) primary of the right wing had a long white tip without a black spot cutting off a "mirror". This pattern is similar to that found in skins of the described race "*thayeri*" of Brooks. The voice of the gulls in this area was higher and hoarser than that of the eastern birds; the usual "kee-ow" cry was consistently given as: "keeeeeeee-yów, ke-yów-ke-yów-ke-yowwww", always with the same three divisions of the second half and the shrill quality. No comparisons could be made of bill size, but the impression was the same as given in skins of *L. a. thayeri*.

Herring gulls were seen on Pine lake, Sulphur lake, Dezadeash lake, Kluane lake, Boulder creek and in small sloughs above tree-line on the Haines road. They were often seen flying from Pine lake to the Alsek river.

**Short-billed gull** [*Larus canus brachyrhynchus* Richardson] was common around Pine lake and was frequently seen in the prairie openings near Pine creek. They used to feed in the grass of the prairie openings and would come for scraps thrown to them. Eventually, they came to sit on the ridge poles of our tents waiting for them. They were seen above tree-line on the Haines road, at Sulphur lake, near Bridge creek, Ptarmigan Heart, and Boulder creek, and on Kluane lake. However, they did not come around the village of Burwash Landing nor our camp there for scraps.

**Bonaparte's Gull** [*Larus philadelphia* (Ord)]. Two pairs were often seen on Pine lake and flying over the muskegs of the neighborhood. This gull was also seen above tree-line on the Haines road, near Little Arm of Kluane lake, at Bridge creek, above tree-line near Ptarmigan Heart and near Jarvis creek.

**Arctic Tern** [*Sterna paradisaea* Pontopidian] seemed to be nesting on Pine lake, Sulphur lake, Kluane lake and near Ptarmigan Heart. None were seen after August 19.

**Western Mourning Dove** [*Zenaidura macroura marginella* (Woodhouse)]. One was seen in the prairie openings near the Dominion Experimental Substation at Pine creek in June.

**Northwestern Horned Owl** [*Bubo virginianus lagophonus* (Oberholser)] was seen near Pine lake, Mile 1013, in deep spruce forest, and heard at Bridge creek in a burned area. The Indians say that when this owl hoots, he says "people are fighting". When an Indian says this he sounds just like a horned owl.

**Great Gray Owl** [*Strix nebulosa nebulosa* Forster]. The author had a fleeting glimpse of this bird in the deep spruce woods on the edge of the Duke river, near Kluane lake. Dr. Johnson saw the bird a few minutes later and perfectly described an owl of this species, although he did not know the species existed.

The Indians described two other owls that they know around Burwash Landing which could only be Richardson's owl [*Aegolius funerea richardsoni* (Bonaparte)] and Ameri-

can hawk owl [*Surnia ulula caparoch* (Müller)].

**Eastern Nighthawk** [*Chordeiles minor minor* (Forster)] was very common in areas occupied by open spruce forest (Porsild's spruce) in the Dezadeash valley and near Kluane lake. Several pairs were seen in an old burn near Bridge creek.

**Rufous Hummingbird** [*Selasphorus rufus* (Gmelin)]. A hummingbird was reported by Mrs. Abbott, wife of the Superintendent of the Dominion Experimental Substation. It had spent some time around her house during July. This species is the only one probable.

**Belted Kingfisher** [*Megaceryle alcyon* subsp.] was seen along all the creeks in the Dezadeash valley from Champagne to Bear creek. Around Kluane lake they were seen at Burwash Landing, the Little Arm, the Big Arm, Christmas creek, Little-Arm creek and Kluane river.

**Northern Yellow-shafted Flicker** [*Colaptes auratus luteus* Bangs] was common in the Dezadeash valley in both deciduous and coniferous woods. They were common, too, around Burwash Landing, Little-Arm creek, Whiskers creek, Henry creek, Ptarmigan Heart and Coulte's creek. They seemed to have left by the 20th of August. Rand (1944) does not accept *borealis* for the northwestern flicker. He considers the series a cline and includes *borealis* in *luteus*.

**Northern Hairy Woodpecker** [*Dendrocopos villosus septentrionalis* (Nuttall)] was seen and heard in the aspen groves near Pine creek, at Burwash Landing, at Whiskers creek and at Boulder creek. They were much less in evidence than flickers.

**Arctic Three-toed Woodpecker** [*Picoides arcticus* (Swainson)] was seen in early June in a burned area near Pine lake and on August 15 in Porsild's spruce near Burwash Landing.

**Alaska Three-toed Woodpecker** [*Picoides tridactylus fasciatus* Baird] was seen in the deep spruce forests, near the Duke river in August and two adults with three young at Boulder creek in August.

**(Eastern Phoebe** [*Sayornis phoebe* (Latham)] was seen in the aspen groves at Pine creek during June. This species is not included in Rand's list (1946). The bird was seen several times in the region of our campsite near Pine creek. It was recognized by lack of wing-bars, large dark head, and tail-wagging. The bird could be confused

with an olive-sided flycatcher, but that bird does not wag its tail and in my experience in the northwest, is a bird of wet, especially black spruce muskegs, making itself conspicuous with its cries.)

**Say's Phoebe** [*Sayornis saya saya* (Bonaparte)] was found around buildings on the edges of prairie openings and in some burned areas along the highway. They were seen at Whitehorse, Champagne, Canyon, Haines Junction, the Experimental Substation, Bear creek, Kluane village, Burwash Landing and the Duke river meadows. The last were seen after snow had fallen, on August 23.

**Alder Flycatcher** [*Empidonax traillii traillii* (Audubon)] nested in the willow muskegs at Mile 1013 and Pine creek.

**Western Wood Pewee** [*Contopus richardsonii richardsonii* (Swainson)] was found in both aspen and spruce woods at Pine creek, in spruce woods at Burwash Landing and in aspen-birch woods above Whiskers creek on the pass to Teacup. There were several still left in the Burwash Landing region on August 23.

**Northern Violet-green Swallow** [*Tachycineta thalassina lepida* Mearns] were seen over prairie openings, usually near houses, at Champagne, Canyon, the Experimental Substation and Burwash Landing. They were seen flocking on August 1 and had left by August 23.

**Bank Swallow** [*Riparia riparia riparia* (Linnaeus)] nested in the silt banks of stream terraces at Canyon and near Kluane village.

**American Barn Swallow** [*Hirundo rustica erythrogaster* Boddaert] nested under the highway bridge at Jarvis creek in June.

**Greater Cliff Swallow** [*Petrochelidon pyrrhonota hypopolia* Oberholser] nested at Champagne, Canyon and Burwash Landing. Ninety-four nests were built this year on the barn at the Experimental Substation. A flock of about thirty was seen far above tree-line between Bridge creek and Deep lake in the evening of July 23. All the swallow left Burwash Landing about the twentieth of August.

**(Purple Martin** [*Progne subis subis* (Linnaeus)]. Either two or three of these were seen at Whitehorse on the last two days of May. These birds were identified by their large size, slow wing beat and all dark coloration. They clearly lacked the white underparts of tree and violet-green swallows. This species is not included in Rand's list (1946).)



**Eastern Canada Jay** [*Perisoreus canadensis canadensis* (Linnaeus)] was very common everywhere. They soon appeared at every camp we made except those far above tree-line. They were present in all types of forest, but were not as numerous in aspen woods as in spruce.

**American Magpie** [*Pica pica hudsonia* (Sabine)] was seen and seemed to be nesting at Champagne, Canyon, Pine creek, Bear creek, Dezadeash lake, Christmas creek, Burwash Landing, Whiskers creek, Ptarmigan Heart and the Duke meadows. They were only found close to some open, grassy or prairie country. At Whiskers creek and Ptarmigan Heart, the tussock muskeg provided this type, but in the other places magpies were near regular prairie openings.

**Northern Raven** [*Corvus corax principalis* Ridgway] was seen at Champagne, Pine lake, Pine creek, Bear creek, along the Haines road, at Slim's river, Christmas creek, at at least six localities along the highway beside Kluane lake, at Bridge creek and Ptarmigan Heart. Ravens were as common as could be expected of a bird of this size and habits. We were told near Watson's lake that they were seen the winter before flying around and feeding when the temperature was 85° below zero, fahrenheit. Along the highway, they were seen near highway camps, but didn't seem to be attracted to them any more than to the lake shores.

**Back-capped Chickadee** [*Parus atricapillus* subsp.]. Duvall (1945, *Auk*, 62, pp. 49-66) suggests these birds may be an undescribed race. He refers them tentatively to *P. a. turneri* of Ridgway.

They were seen in the aspen groves at the Experimental Substation near Pine lake in Spruce forest, at Marshall creek, at Champagne and were common near Burwash Landing in the open spruce woods. They did not extend into the country north of Kluane lake and whenever seen, they were in the company of brown-capped chickadees.

**Columbian Brown-headed Chickadee** [*Parus hudsonius columbianus* Rhoads] were common in spruce and aspen woods through the whole region. Sooner or later we would find a flock of them wherever there were trees.

**Red-breasted Nuthatch** [*Sitta canadensis* Linnaeus] was seen and heard in spruce woods near Pine lake in June, near Burwash Landing on August 10 and at Mile 1073 on August 13.

**Eastern American Robin** [*Turdus migratorius migratorius* Linnaeus] were common in the open spruce forests except near Boulder creek and were especially common in the aspen groves at Pine creek. They appeared wherever there were trees along the Haines road. They had begun to flock by August first, but were still present in the first week of September.

**Northern Varied Thrush** [*Ixoreus naevius meruloides* (Swainson)] was heard near Dalton Post in June and both seen and heard near Burwash Landing on August 25.

**Hermit Thrush** [*Hylocichla guttata* subsp.] Both subspecies, *guttata* of Pallas and *fazoni* of Bangs and Penard, are reported from the Yukon Territory near this area. Songs were heard in the aspen groves on the Experimental Substation and in other scattered places in the Dezadeash valley and at Bridge creek.

**Olive-backed Thrush** [*Hylocichla ustulata swainsoni* (Tschudi)]. Songs of these birds were heard commonly in both spruce and aspen woods in the Dezadeash valley and they were seen on several occasions. They were common, too, near Kluane lake. A nest was found on the ground among *Calamagrostis purpurascens*, *Arctostaphylos uva-ursi* and *Lupinus arcticus*, near a *Salix glauca* bush in the Porsild's spruce-balsam poplar open forest on the lake shore. Although this is an unusual nesting site, I am sure of the identification because I saw the bird twice from about fifteen feet in excellent light.

**Mountain Bluebird** [*Sialia currucoides* (Bechstein)]. Pairs were seen in June at Champagne, Canyon, Pine creek and near Bear creek. They were seen in July and August near Burwash Landing, the Duke river meadows and the Donjek river. A flock of twenty was seen near Burwash Landing from August 15 to 19. None were seen after the 20th.

The birds at Canyon nested in an old bank swallow hole. Everywhere found, these birds were in the open forest of Porsild's spruce near grassland. One pair, that at Bear creek, was on the edge of a large cleared area beside the highway.

**Townsend's Solitaire** [*Myadestes townsendi* (Aubudon)] was seen at the summit near Bear creek and at Mile 134 on the Haines road in June, and near Bridge creek in July. They seemed to stay in the scattered spruces near tree-line during the breeding season. With the first snows, they came down from higher land and several were seen

near Burwash Landing in the last two weeks of August.

**Eastern Ruby-crowned Kinglet** [*Regulus calendula calendula* (Linnaeus)] was seen in several deeply wooded muskegs of Alberta white spruce in the Dezadeash valley during June. Two were seen near Burwash Landing with a migrating flock of myrtle and pileolated warblers on August 26.

**Eastern American Pipit** [*Anthus spinoletta rubescens* (Tunstall)] appeared in flocks of 10-30 on the Kluane lake beaches and along the highway from the Donjek river to Christmas creek after August 20, as soon as the first snows covered the tops of the mountains.

**Bohemian Waxwing** [*Bombycilla garrula pallidiceps* Reichenow] was seen at Kathleen river in mid-June and at Bridge creek, Whiskers creek and Ptarmigan Heart in July. They were common along the highway near Kluane lake through July and August. Wherever found, they seemed to prefer the more open spruce forests.

**(Blue-headed Vireo** [*Vireo solitarius* subsp.]. One of these was seen in the aspen groves near Pine creek in June. This species is not included in Rand's list (1946).)

**Tennessee Warbler** [*Vermivora peregrina* (Wilson)] nested in the vicinity of *Salix glauca* and *Salix myrtillifolia* bushes on the margin between the aspen groves and willow muskeg at Pine creek. They were missed near Burwash Landing.

**Orange-crowned Warbler** [*Vermivora celata* subsp.]. Both subspecies seem to occur in this region, but C.H.D. Clarke collected an adult male of *V. c. orestera* of Oberholser at Burwash Landing, July 6, 1943. Mr. Godfrey suggests *oresteria* seems to be the breeding form and says that they collected two apparently migrant specimens of the nominate race in August at Carcross.

**Northern Yellow Warbler** [*Dendroica petechia amnicola* Batchelder] nested on the edges of the willow muskegs at Pine creek and was seen in July at Burwash Landing and Bridge creek.

**Alaska Myrtle Warbler** [*Dendroica coronata hooveri* McGregor] was common everywhere in the Dezadeash valley in June. They were seen in July in the spruce woods near Burwash Landing, at Bridge creek, Whiskers creek, Henry creek, Ptarmigan Heart and Boulder creek. They were still migrating through Burwash Landing on August 26.

These, chickadees, juncos, and Canada jays seemed to be the only inhabitants of most of the Alberta spruce forest.

**Black-poll Warbler** [*Dendroica striata* (Forster)] was seen in the aspen groves at Pine creek in June. This is a departure from the familiar habits of the species in the East where it is in general a bird of spruce forests. However, the bird has been seen regularly in Alaska in 1949 and 1950 in flood plain forests, 60% white birch and 40% white spruce, where it seems to prefer this type. It is also commonly found in birch thickets near tree-line in the mountains of New England and eastern Canada.

**Northern Pileolated Warbler** [*Wilsonia pusilla pileolata* (Pallas)] was seen in June at scattered places in the Dezadeash valley and in August in migrating flocks of myrtle warblers near Burwash Landing. They were found in both types of forest, but especially in spruce. They were seen August 26.

**Rusty Blackbird** [*Euphagus carolinus* (Müller)] was seen in June at Canyon creek, Jarvis creek and near Pine lake. They were seen on migration near Burwash Landing on August 27 and 31.

**(Purple Finch** [*Carpodacus purpureus* subsp.]. An immature male was seen rather poorly at Canyon in early June. This species is not included in Rand's list (1946).)

**Common Redpoll** [*Acanthis flammea flammea* (Linnaeus)]. A flock of thirty was seen near Burwash Landing on August 26.

**Pine Siskin** [*Spinus pinus pinus* (Wilson)] was abundant in all the spruce woods along the highway from Champagne to the Duke river and in the valleys of the creeks that flow into Kluane lake from the north. They were seen even above tree-line, but were entirely absent from Ptarmigan Heart valley probably because there was a relatively poor cone-crop there. The spruces were in an especially good cone-crop year and these and white-winged crossbills were, very common indeed.

**Red Crossbill** [*Loxia curvirostra bendirei* Ridgway]. A flock of about twelve were seen and heard at Kluane lake on August 19, although there is no pine forest within nearly two hundred miles. They were in a stand of Porsild's spruce.

**Northern White-winged Crossbill** [*Loxia leucoptera leucoptera* Gmelin]. These were common everywhere in the spruce forests in the Dezadeash valley during June and around

Kluane lake in late July and August. They were seen everywhere there is spruce north of Kluane lake, but were not especially common. These and siskins were seen in numbers as late as the first week in September. The spruce cone crop in 1948 was especially heavy in the Shawkak valley, but not noticeably so in the rest of the area.

**Kodiak Savannah Sparrow** [*Passerculus sandwichensis anthinus* Bonaparte] was common in open prairies along streams at Pine lake, near Pine creek and near Jarvis creek. They were common everywhere above tree-line in the willow-birch scrub and in the *Eriophorum* tussocks area near Henry creek, near Ptarmigan Heart and near Boulder creek. They seem to prefer areas of heath shrubs where there is a lot of grassy vegetation too, rather than pure grassy regions.

**Eastern Slate-colored Junco** [*Junco hyemalis hyemalis* (Linnaeus)] was common in both types of woods in the Dezadeash valley in June and around Kluane lake in August. They were seen everywhere north of Kluane lake, even some distance above tree-line. They are one of the most characteristic birds of the region and were still present the first week of September.

**Western Tree Sparrow** [*Spizella arborea ochracea* Brewster] were common and often heard singing in the lower altitude birch-willow muskegs in the Dezadeash valley and near Kluane lake. North of the lake, they were common in the muskegs and were the most conspicuous bird above tree-line wherever we went. They were still present the first week of September.

**Eastern Chipping Sparrow** [*Spizella passerina passerina* (Bechstein)] was seen on the edges of open country in thin spruce or aspen woods in the Dezadeash valley and near Burwash Landing. There were at least six occupied localities.

**Gambel's White-crowned Sparrow** [*Zonotrichia leucophrys gambelii* (Nuttall)] was very abundant and conspicuous on all shrubby muskegs throughout, and they seemed to be restricted to the higher shrubs on the margins. Thus they were absent above tree-line and in the forests.

**Golden-crowned Sparrow** [*Zonotrichia coronata* (Pallas)] Several ere heard singing in late June above tree-line about Mile 99 on the Haines road.

**White-throated Sparrow** [*Zonotrichia albicollis* (Gmelin)] was heard singing at Pine creek in early June.

**Eastern Fox Sparrow** [*Passerella iliaca iliaca* (Merrem)] was seen and heard in the willow muskeg at Pine creek. Their song was a departure from the already variable songs heard in the East.

zee      pur-zee-lee-chew      chidichidichidi  
zay      zew      trill  
*slow*      *very fast*

**Lincoln's Sparrow** [*Melospiza lincolnii lincolnii* (Audubon)] was doubtfully seen in Pine creek muskeg in early June.

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## RECORDS OF THE CREEK NORTHERN CHUB FROM ONTARIO<sup>1</sup>

A. E. ALLIN

Fort William, Ontario, Canada

DURING the past ten years, we have collected fishes in that portion of the District of Thunder Bay, Ontario, extending in a narrow strip along the north shore of Lake Superior from the Minnesota-Ontario boundary, northeast 160 miles to Rossport. On twelve occasions from nine localities, we have taken specimens of the Lake Chub, *Couesius plumbeus* (Agassiz). The single individual collected at one station proved to be a Lake Northern Chub *Couesius plumbeus plumbeus* (Agassiz) the form considered common throughout much of Ontario but the fish comprising the other eleven collections were Creek Northern Chub *Couesius plumbeus dissimilis* (Girard) a form not previously reported from the Province.

Most of our collecting was done while angling for Eastern Brook Trout *Salvelinus*

*fontinalis fontinalis* (Mitchill). Some specimens were taken while angling, but the majority were caught in a small trap-net. A few fish were received from fellow anglers who wished them identified. Throughout the investigations I received the co-operation of my son, David. On August 13, 1946, while I was fishing in Beartrap Lake, west of Rossport, David set a trap-net and later brought me a large number of cyprinid fishes which have been identified by Dr. Samuel Eddy, Department of Zoology, University of Minnesota, as the Creek Northern Chub, *Couesius plumbeus dissimilis* (Girard). Dr. Eddy has identified as the same form collections taken as follows:

Current River, McGregor Township, June 5, 1949 (collected by E. Heslop).

Nishin Lake, 15 miles west of Rossport, June 11, 1949.

<sup>1</sup> Received for publication July 18, 1952.

McIntosh Lake, Dorion Township, September 3, 1949.

Study of material previously collected, revealed a single specimen taken in Loch Lomond near Fort William, July 5, 1942 and two small specimens taken by David and myself angling in the McIntyre River, Port Arthur, July 26, 1946.

Further collecting has added the following records:

Nishin Lake, July 4, 1948; June 21, 1952.

Corbetts Creek, Oliver Township, July 13, 1949 (collector C. E. Garton).

McIntosh Lake, June 24, 1950.

Whitefish River, Strange Township, July 8, 1951.

A further specimen of *Couesius plumbeus* was collected June 10, 1945 in the Cypress River, 400 yards from where it flows into Lake Superior, 20 miles west of Rossport. Both Dr. Eddy and Dr. W. B. Scott, Curator of Ichthyology and Herpetology, Royal Ontario Museum of Zoology and Paleontology, Toronto, identified it as the typical form *plumbeus*, the Lake Northern Chub.

*Couesius plumbeus* (Agassiz) is widely distributed across Canada in one of three forms. According to Dymond (1947), *greeni* occurs in northern British Columbia, *plumbeus* from the Mackenzie River region to the Great Lakes, and *dissimilis*, a more southern form, from the eastern slope of the Rocky Mountains across the northern portion of the Great Plains. Hubbs and Lagler (1949) give the range of *dissimilis* "from Wyoming to the Mackenzie drainage on the plains of Canada...; eastward across the northern part of the Great Plains... to the Keweenaw Peninsula of Michigan. Almost entirely in creeks." Although Nash (1908) stated "The Lake Superior form is *C. p. dissimilis*", Radforth (1947) recorded the Ontario population as "largely if not entirely subspecies *C. p. plumbeus* which occurs throughout northern Canada chiefly in lakes except when it enters tributary streams in spawning season." She included on her spot-map records from areas adjacent to the region we have studied, probably including those of Dymond (1926) and Koelz as reported by Hubbs and Brown (1929). Dymond investigated Lake Nipigon and vicinity in 1922-23. He found this species frequently in the lower stretches of small streams and noted its occurrence in Lake Nipigon. Dr. Walter Koelz took specimens in 1922 while studying

the coregonid fishes of the area. Neither of the above authorities reported the form which they collected.

Eddy and Surber (1943) have reported the subspecies *plumbeus* from the Arctic and Lake Superior drainages of Minnesota. Collections from the Lake Superior drainage include specimens from the Brule River, Cook County, adjacent to our southern boundary. They add, however, that "Hubbs has found the subspecies *C. plumbeus dissimilis* in streams tributary to Lake Superior." One might assume these were the Keweenaw records of Hubbs and Lagler (1949), but in a personal communication Dr Eddy emphasizes these streams were ones draining into the north side of Lake Superior. Smith and Moyle (1944) in a study of the Minnesota streams flowing into Lake Superior found this cyprinid "the most abundant species in the mouths of most north shore streams and [it] occurs commonly in wide, slow stretches back from the shore in... rivers." They ascribed their specimens to *C. p. plumbeus*. Extensive investigations of Isle Royale, Michigan, have been made by various workers. Hubbs and Lagler (1947) reported *C. p. plumbeus* as one of the commonest fishes in the lower reaches of streams and about the entire shore of the island. They also found it in Lake Desor, an inland lake, with an elevation of 235 feet above Lake Superior.

From the above review of the literature it would appear that our collections of *Couesius plumbeus dissimilis* are the first from Ontario and the second from the Lake Superior drainage apart from indefinite records for unnamed north shore streams. It has been considered a stream fish, hence its name Creek Northern Chub but we have found it in rock-bound inland lakes of moderate size as well as in the headwaters of local streams. We have never taken it in the small boggy lakes so numerous in the region and inhabited by *Chrosomus eos* (Cope). *Pfrille neogaea* (Cope), *Pimephales promelas* Rafinesque and *Eucalia inconstans* (Kirtland). Its one constant associate has been the Brook Trout but we have taken twenty other species in waters inhabited by this cyprinid. It may be more than coincidence that the specimen typical of *plumbeus* was taken from the lower stretch of a stream near its Lake Superior outlet. It was in such locations that Ameri-

can ichthyologists took the majority of their specimens of the typical form.

Due to its relative abundance and distribution, the Creek Northern Chub is probably of considerable economic importance as food for the Brook Trout as well as for the common Lake Trout *Cristivomer namaycush namaycush* (Walbaum) which also occurs in the lakes preferred by this species. Recently the Northern Smallmouth Bass *Micropterus dolomieu dolomieu* Lacépède has been introduced into local lakes including Beartrap. It, too, will undoubtedly utilize this minnow as food. It is a hardy species and anglers use it for bait, frequently transporting a supply from one body of water to another which may be 100 miles distant. There is a suggestion that the species was introduced into Nishin Lake from Beartrap during the past 15 years. In the latter lake they rarely attain a total length of 100 mm. but in Nishin they frequently exceed 150 mm. in length and may weigh 50 gr. This is a common phenomenon where a species is introduced into a new area. In Nishin Lake its vertebrate competitors are *Pimephales promelas promelas* Rafinesque which is present in small numbers, the Common Newt *Triturus viridescens* (Rafinesque), and the Mink Frog *Rana septentrionalis* Baird. Angling for Brook Trout has rapidly deteriorated in recent years and I believe the introduction of the Northern Chub is directly involved. It occurs in immense numbers, schools covering the gravel bottoms in late June when they prepare to spawn. Undoubtedly it provides ample food for adult trout, and it may compete with the young trout for food. Unfortunately we have not had time to study the food of the species. Were it larger, angling for the species would provide good sport for it takes both live bait and the artificial fly readily. This also interferes with angling in Nishin Lake since it is almost impossible to make a cast without catching one of these minnows.

#### SUMMARY

1. The Creek Northern Chub *Couesius plumbeus dissimilis* (Girard) is reported from the southern portion of Thunder Bay District, Ontario.

2. It occurs commonly in the rock-bound lakes and upper stretches of streams and rivers of the area.
3. The minnow is of some economic importance as food for Brook and Lake Trout which are the principal game fishes of the region.
4. It is also utilized as bait by fishermen angling for the above species. In this manner it may be introduced into new lakes, upsetting balances previously existing. It is believed this has occurred in Nishin Lake with a resultant deterioration of Brook Trout fishing.

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PHYLLODOCE COERULEA IN NORTH AMERICA<sup>1, 2</sup>

W. J. CODY

Hultén<sup>3</sup> in his comprehensive study of arctic and boreal plants postulated two types of species, viz. rigid and plastic. Rigid species are those which were removed from large areas during the Pleistocene glaciation, and thereby, either wholly or for the most part, have lost the power to spread and populate

new areas. These species remain today approximately in the same areas as those occupied by them when the ice was at its maximum extension. Plastic species are those which did not lose the power to spread, and which have re-occupied areas from which they were removed during the Pleistocene.

<sup>1</sup> Received for publication August 13, 1952.

<sup>2</sup> Contribution No. 1200 from the Division of Botany and Plant Pathology, Science Service, Canada Dept. of Agriculture, Ottawa, Canada.

<sup>3</sup> Hultén, E.: Outline of the History of Arctic and Boreal Biota during the Quarternary Period. Stockholm, 1937.

The distribution of *Phyllodoce coerulea* (L.) Bab. was described by Hultén (loc. cit. page 74) as one of the most difficult of the Arctic-montane species to interpret. By



Fig. 1. Actual and hypothetical area of *Phyllodoce coerulea* (after Hultén).





Fig. 2. Major elementary areas of the circumpolar plants (after Hultén).

comparing the distribution pattern of *P. coerulea* with species of similar range but less disjunct occurrence, he deduced the probable routes through which this species migrated to attain its then known distribution. The hypothetical area once populated by *P. coerulea* and from which it has since been removed by glacial action and climatic factors, was demonstrated in his fig. 7 (loc. cit. page 95), here reproduced as fig. 1. On this map, the actual distribution of this species as known to Hultén, is represented by hatched lines, the hypothetical area is circumscribed by a broken line. This hypothetical area, in North America, included

all of Alaska and Yukon, with the exception of the northern coast, the continental Northwest Territories, Southampton Island, southern Baffin Island, southern Greenland, Iceland, northern Quebec and Labrador south through western Newfoundland and Gaspé to the New England States.

Fig. 2 (Hultén fig. 11 loc. cit. page 119) illustrates the major elementary areas of circumpolar plants. A comparison of fig. 1 with fig. 2, shows that *P. coerulea* is present in nearly all but the most southern of these rigid or elementary areas. This species would therefore have been an excellent example of a rigid species.

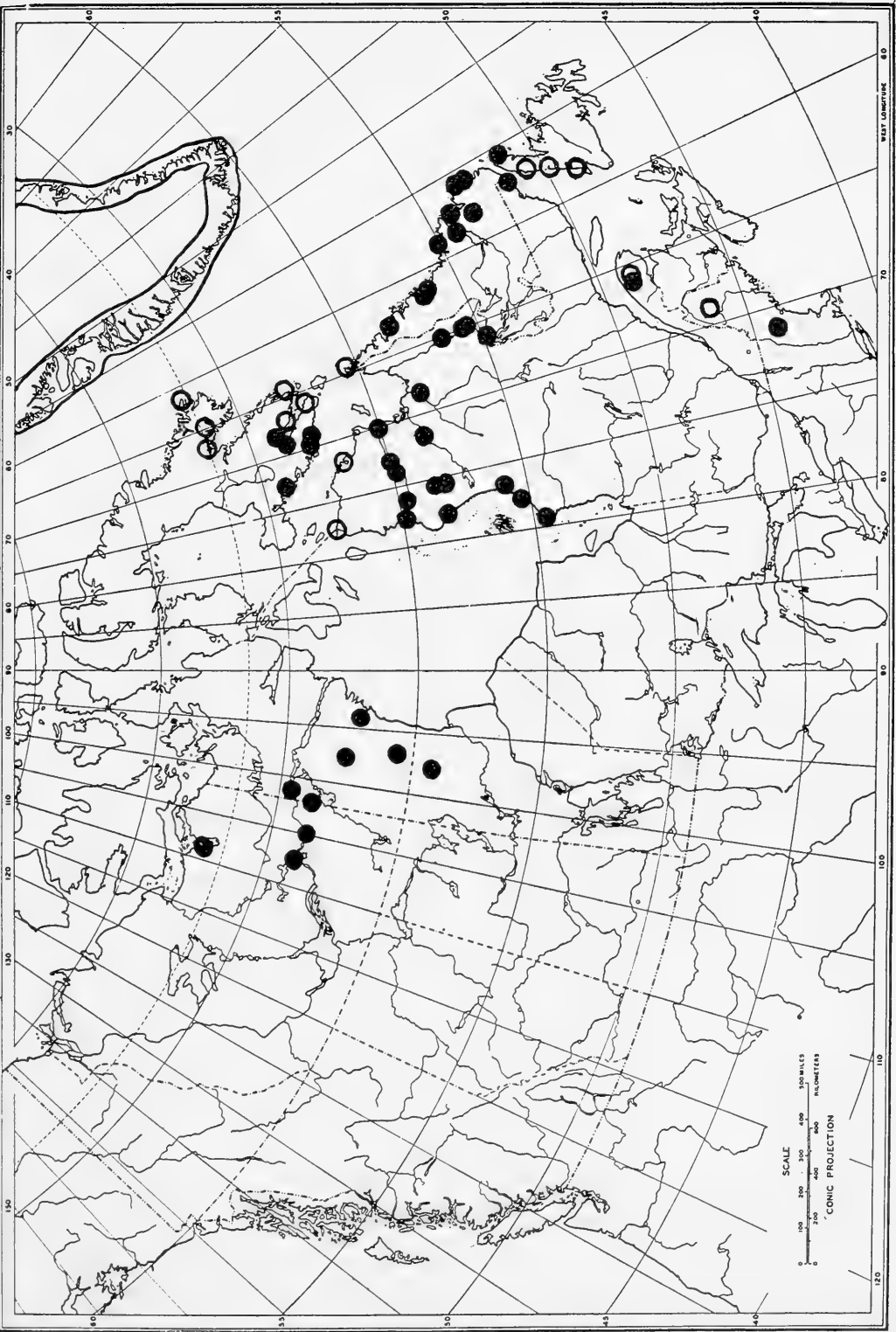


Fig. 3. Distribution of *Phyllocladus coerulea* in northeastern North America, as known from herbarium specimens (dots) and published record (circles); occurrence in coastal Greenland is considered to be relatively continuous.

Recent collections in northeastern North America have shown, however, that *P. coerulea* is not a rigid species in that region, for it has been found to be widely distributed throughout an area which was heavily glaciated during the Pleistocene (see fig. 3). It has thus repopulated much of the area which Hultén described as its probable migration path across northern North America.

The known distribution for North America can now be given as follows: western Alaska, eastern Mackenzie District, continental Keewatin District, northern Manitoba (*D. K. Brown* 388, Sept. 15, 1950, decumbent in shade of spruce-larch grove at edge of lake in sandy peaty soil, MacLeod Lake, (approx. 59°10'N 97°30'W) DAO; new to the flora of Manitoba), southern Baffin Island<sup>4</sup>, around the coast of Greenland north to at least 74° north latitude in West Greenland<sup>5</sup> and to 72°10' north latitude in East Greenland<sup>6</sup> Northern Peninsula and Long Range Mountains of Newfoundland<sup>7, 8, 9</sup>, the mountains of Gaspé, and New England<sup>10</sup>.

In a recent letter Dr. Hultén has kindly provided the following interesting informa-

<sup>4</sup> Polunin, N.: Botany of the Canadian Eastern Arctic. Part 1. Pteridophyta and Spermatophyta, Canada Department of Mines and Resources, Nat. Museum Bulletin. No. 92: 310. 1940.

<sup>5</sup> Persild, M. P.: The flora of Disko Island and the adjacent coast of West Greenland, Medd. om Gronland 58: 133. 1920.

<sup>6</sup> Seidenfaden, G., and T. Sorenson: The vascular plants of northeast Greenland from 74°30' to 79°00' N. Lat. Medd. om Gronland 101 (4): 176-177. 1937.

<sup>7</sup> Fernald, M. L.: A Botanical expedition to Newfoundland and southern Labrador. *Rhodora* 13: 133. 1911.

<sup>8</sup> Fernald, M. L.: Two summers botanizing in Newfoundland. *Rhodora* 27: 116, 223. 1926.

<sup>9</sup> Fernald, M. L.: Recent discoveries in the Newfoundland flora. *Rhodora* 35: 279. 1933.

<sup>10</sup> Fernald, M. L.: The vascular plants of Mount Katakhdin. *Rhodora* 3: 175. 1901. sub nom *Bryanthus taxifolius*.

<sup>11</sup> Rikli, M.: Die arktisch — subarktischen Arten der Gattung *Phyllodoce* Salisb. Vierteljahrsschrift der Naturforschenden Gesellschaft in Zurich, LXVI: 324-334. 1921.

tion regarding the distribution of this species: "A locality west of Great Slave Lake is very remarkable as also one in Manchuria on the Korean border. The locality in northern Italy is given in old floras and may be doubtful". The author has seen no specimens from these areas.

Rikli<sup>11</sup>, has given the following distribution of this species for eastern North America: "In N. Amerika tritt sie in den Gebirgen der atlantischen Staaten der Union, von den White-Mountains New Hampshires durch Maine, Ontario, Quebec bis Labrador, so noch in der Umgebung von Ramah (c. 59° n) auf." The author has seen no specimens from Ontario and has not been able to find any other record of its occurrence in that province. The presence of *P. coerulea*, at least in the southern part of Ontario as indicated by this distribution, is highly doubtful.

Specimens have been examined in the Herbarium of the Division of Botany and Plant Pathology, Science Service, Canada Department of Agriculture, Ottawa (DAO) and the Herbarium of the National Museum of Canada at Ottawa. The author is indebted to Mr. Marcel Raymond, Montreal Botanical Garden, for listing the specimens in the Herbarium of that Institution and the Herbarium of the University of Montreal. He is also indebted to Dr. Bernard Boivin for his advice in the preparation of this manuscript, and to Dr. Eric Hultén for his permission to reproduce the maps from his work.

### Conclusion

*Phyllodoce coerulea* is shown to be an example of what Hultén has described as a rigid species. It is demonstrated here, however, that at least in northeastern North America, it is not a rigid but a plastic species.

## NOTES ON FOOD HABITS OF WATERFOWL IN THE INTERIOR OF UNGAVA PENINSULA<sup>1</sup>

NICHOLAS POLUNIN<sup>2</sup> and CARL R. EKLUND<sup>3</sup>

THE INTERIOR of Ungava Peninsula in northern Quebec was studied in the summer of 1949 for the primary purpose of determining waterfowl species-distribution and

productivity. This study was part of the annual survey of the Canadian waterfowl breeding grounds conducted jointly by the Canadian Wildlife Service and the U.S. Fish and Wildlife Service, as reported upon by Crissey, *et al.* (1949). The survey was carried out in cooperation with the Arctic Institute

<sup>1</sup> Received for publication October 4, 1952.

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of North America and was financed by a grant from the Institute with funds provided by the United States government<sup>4</sup>. The field party consisted of Leon D. Cool, Game Management Agent — Pilot of the Fish and Wildlife Service, and Eklund, with Polunin joining in for a few days toward the end.

Bird skins representing twenty-one species and skins and skulls of three mammal species were collected, together with stomach contents of Canada geese, a Black Duck, and an Old-squaw, and crop contents of Willow Ptarmigan and Rock Ptarmigan. In addition, plants were collected at seven ground stations occupied in the interior. Polunin made the stomach analyses of the geese and identified all plant collections. Contents of the duck stomachs were determined at the U.S. Fish and Wildlife Service Patuxent Research Refuge.

Field work was carried out between June 29 and August 3, 1949. The main bases of operation were the military air base at Fort Chimo on the Koksoak River, and Payne Lake at Latitude 50°19'N., Longitude 73°27' W. The U.S. Air Force parachuted oil and gasoline at the camp on Payne Lake, and from this point it was possible to occupy other ground stations within a 200-mile radius. Operations were carried out with a single-engine Fairchild 24 equipped with pontoons.

Aquatic plants which are of importance for waterfowl food appeared to be almost entirely lacking in the area studied. In any event, the aquatics are relatively unimportant in comparison with the semi-aquatic or terrestrial plants. In an effort to obtain an indication of important food sources, stomach contents of an Ungava Canada Goose (*Branta canadensis interior* Todd), and an Old-squaw (*Clangula hyemalis*) were collected at Payne Lake on July 22. Three other geese of this same subspecies and a Black Duck (*Anas rubripes*) were taken on Gregory (Octopus) Lake at Latitude 58°29' N., Longitude 70°06' W. on July 27. Stomach contents from these specimens are the basis for these notes. While this is an extremely small sample it may be of some interest and value as apparently no waterfowl-stomach collections had previously been made in these areas.

Payne Lake is the largest of the Ungava lakes within the tundra region, and vegetation on the surrounding terrain is characterized by a vast array of mosses and lichens, sedges (*Carex* spp.), grasses, willows, dwarf

birch (*Betula glandulosa*), baked-apple or cloudberry (*Rubus chamaemorus*), narrow-leaved Labrador tea (*Ledum palustre* var. *decumbens*), and arctic blueberry (*Vaccinium uliginosum* var. *alpinum*). The plant communities are in general comparable with those described for nearby coastal localities by Polunin (1948). Gregory Lake is located not far south of the tree line in what is commonly termed forest tundra, and the terrain and vegetation of the area have been described in outline by Polunin (1949).

### STOMACH ANALYSES

The gizzard contents of the goose specimen collected at Payne Lake looked like gritty grey mud with some intermixed organic shreds. It gave the impression that the bird had been feeding on algal-invested mudflats or lake-bottoms, but microscopic examination immediately showed the organic material to be of vascular plant origin, most of it evidently resulting from the breakdown of leaves of sedges and/or grasses. Organic material composed about half of the bulk, and about half of this was of narrow shreds of leaf, up to nearly 1 cm. long, containing usually a single vascular bundle; the other half consisted of still further broken down, more or less colloidal, particles. The remainder was of mineral origin and consisted of coarse sand or grits up to 3 mm. in diameter, and finer material including a considerable proportion of whitish sand. The total contents of the gizzard measured about 20 cc. The oesophagus was empty.

In goose specimen 1 from Gregory Lake the oesophagus and gizzard contents totaled about 18 cc., of which approximately one-quarter by bulk was mineral material of fine whitish sand, with some coarse sand or grits from 1 to 3 or occasionally 4 mm. in diameter. The remaining three-quarters by bulk was of organic material, much the greater part being of portions of leaves of *Carex* spp. (mostly of *C. aquatilis*) up to 10 cm. in length. Also determined were the tip of a branch of *Vaccinium uliginosum* var. *alpinum* bearing three small leaves; four small leaves of *Polygonum viviparum*; a scrap of coniferous "touch-wood" (such as is often found floating on lakes and pools in forested areas, and which is apt to be left on herbage or shores when the water recedes); the shoot of a dicotyledonous plant lacking leaves; five leaves of *Pedicularis flammea*; and a few small leaves apparently of a grass. This last could have been the almost ubiquitous *Poa arctica*. Most of the leaves of

<sup>4</sup> Data obtained will be used by Eklund in a doctorate thesis at the University of Maryland.

the *Polygonum* and the *Pedicularis* were complete with petioles, and almost all of the material appeared to have been browsed when fresh. These are typically marsh plants, though not exclusively so. No algal or other cryptogamic material was found.

The contents in the gizzard and the oesophagus of the second goose specimen from Gregory Lake totaled about 27cc. About one-quarter of the bulk was of mineral material, largely coarse sand and grits up to 4 mm. in diameter. The remainder consisted of plant material, of which about two-thirds was too disintegrated to identify although clearly it was for the most part of monocotyledonous origin — chiefly shreds of leaf material of sedges and/or grasses. Identifiable among the larger pieces were fairly numerous scraps of leaves of *Carex* spp.; about ten stems of *Juncus* spp.; fifteen pieces of leaves of, apparently, *Luzula parviflora* (several were clearly of this species, being characteristic and nearly 1 cm. wide); several scraps of *Stellaria longipes* s. l. stems with attached leaves; and four scraps of *Polytrichum* cf. *alpinum*. Other, smaller scraps of mosses (2 of *Hypnum* sp. and 3 of *Bryum* sp. or spp.) were included, perhaps by chance; pieces of leaf of *Polygonum viviparum*; scraps of two different, black and withered leaves of *Salix* sp.; the top of an inflorescence of *Calamagrostis neglecta*; three short pieces of slender grass stem which could have been from the *Calamagrostis*; and two fresh-looking leaves of *Cochlearia officinalis* s. l. which suggested seashore feeding although this plant in some forms is apt to occur in marshy and some other habitats inland. Although there was little flowering or fruiting material on the whole, there was found one characteristic part of an inflorescence of *Carex vaginata* and another of *Poa arctica*, and what might have been young fruits of *Luzula parviflora*. Far more important in contributing such bulk as to suggest some degree of selective feeding were (1) stems of *Equisetum arvense* which comprised perhaps one-seventh of the total bulk, and (2) a lesser but still considerable amount of leaf material of *Achillea millefolium* s. l., which suggested a drier habitat than most of the other determinable material. *Equisetum arvense*, while often plentifully scattered in marshes, grows gregariously in drier, especially sandy situations which it may colonize vigorously, and its bulk in this material suggested that the bird might have been feeding in such an area, where it would be more likely to

find the *Achillea* than in moist habitats. This is supported by the dense branching of the *Equisetum* material, which in this form is more typical of dry than of moist habitats. Some very narrow, indeterminable grass leaves up to 8 cm. in length were also found in this sample.

The stomach contents of the third goose specimen from Gregory Lake were very similar to those of specimen 1 from this lake, though the total volume was larger, being about 30 cc. The pieces of *Carex* leaf tended to be larger, some being as much as 15 cm. long. There appeared to be less mineral matter than in the other specimens, the amount being roughly estimated as about one-sixth of the total volume. Leaves or portions of leaves of *Carex* spp. composed most of the bulk. These tended to be softer and narrower than in specimen 1, and they appeared to consist substantially of *C. canescens*, of which there were also about a dozen young flowering axes represented in the material. Some were advanced enough for determination but others may possibly have belonged to *C. brunnescens*, as suggested by some of the narrow leaves. There were also at least four flowering axes of what appeared to be *Carex aquatilis*, although they were too young for certain determination. Also identified were a single flowering axis of *Juncus albescens* and several "budding" ones apparently of *J. filiformis*. The only dicotyledonous material detected consisted of ten more or less whole leaves of *Pedicularis flammæa* and two of *Polygonum viviparum*, all of which appeared to have been in a fresh condition when eaten. There were also included a few very narrow and scabrous leaves apparently of some grass. In this sample the material seemed to be less broken down than in the second specimen from Gregory Lake, although practically all probably came from the *Carex* leaves which appeared to form the main article of diet.

Stomach contents of an Old-squaw Duck contained 3.5 cc. by volume, of which 75 percent was composed of grit. The food content was 100 percent animal matter, and this consisted of fragments of several *Caddisfly* larvae and their cases (*Trichoptera*).

The contents of the Black Duck stomach contained 3.8 cc. by volume of which 2 cc., or 53 percent, was grit. The food eaten consisted of 97 percent vegetable matter and the remainder was animal matter. The plants consisted of 5 percent crowberry seeds (*Empetrum nigrum*); 3 percent mare's tail seeds (*Hippuris vulgaris*); 3 percent butter-

cup seeds (*Ranunculus* sp.); 1 percent seeds of cinquefoil (*Potentilla* sp.); 5 percent immature *Carex* sp. seeds; 35 percent finely-ground fibers from a seed plant, possibly *Carex*; and 45 percent finely-ground filamentous algae. The latter may have been taken incidentally to the feeding on more desirable plant foods. The animal matter was composed of fragments of diving beetle (*Colymbetes* sp.), traces of water mites, and fragments of operculi from several snails.

Only the most tentative conclusions can be drawn from these limited samplings. It may be said that the geese in these areas, and at this time, tend to feed predominantly on monocotyledonous plants that grow in damp situations, since in all stomach contents collected the main bulk was of leaves of sedges, grasses, or grass-like plants, though on occasion there was a substantial admixture of stems of *Equisetum* and, in others, what appeared to be more than chance scraps of leaves of *Pedicularis flammula*, *Polygonum viviparum*, and even in one instance of *Achillea millefolium* s.l. One-sixth to one-half of the total volume of contents consisted of mineral matter. The Black Duck, likewise, fed principally on vegetable matter. Food taken by the Old-squaw Duck consisted of animal matter, as would be expected. In this respect it might be said that lack of insect food in Ungava during the summer, would never be a limiting factor in the distribution of the Old-squaw!

No sign of Algae, Lichenes, Bryophyta, or Fungi was observed in the geese, except for what looked like a smut on one of the sedges, and the few, probably chance, scraps of mosses found in one sample. Apart from the predominant sedges and/or grasses, a considerable range of both monocotyledonous and dicotyledonous material was found, apparently indicating a lack of precise selectivity, though its total bulk seemed usually to be negligible.

In goose specimens 1 and 3 from Gregory Lake the birds appeared to have been feeding largely or entirely in marshy or other wet areas along the lakeshore, for with one exception all of the plants identified in the gizzards and oesophagi were typical marsh plants, and although some are able to grow in other habitats they rarely do so in abundance or together. The exception is

*Juncus filiformis*, which in this region is more characteristic of sheltered grassy slopes and late-snow areas, although it also occurs on wet shores and occasionally in marshes. There seems no reason to doubt that the goose taken at Payne Lake had also been feeding in a similar area. Nothing was identified from the contents of its gizzard, but the material appeared to be all of monocotyledonous origin, and other land habitats are not populated predominantly by such plants in this region.

Plants found in the second goose specimen taken at Gregory Lake can occur in marshes, and some are largely restricted thereto (including the frequent hummocks in them), while several are more characteristic of other habitats — *Cochlearia* of seashores, *Stellaria longipes* and *Polytrichum* of drier areas, and *Equisetum arvense* and *Achillea millefolium* of well-drained situations, at least when growing in any abundance in the vicinity. Accordingly, the impression is gained that this bird fed partly in marshes and partly on sandy banks nearby, such as are plentiful around the shores of Gregory Lake. In general, however, the sedgy marshes that develop most luxuriantly around lakes and tarns in the North, with perhaps some of the damper grassy plains of extensive flat areas, appear to constitute the favorite summer browsing grounds of geese, as has frequently been observed in Spitsbergen as well as in various parts of the Canadian Arctic Archipelago (Polunin, 1948).

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## NOTES AND OBSERVATIONS

**Echinochloa walteri** re-instated in Ottawa District flora<sup>1</sup>.—In Macoun's Catalogue of 1888 there is the record under *Panicum Crusgalli* var. *hispidum* Ell., "Along the Nation River, at Casselman. (Fletcher, Fl. Ott.)". No specimen was preserved and Dr. Malte in his manuscript notes, prepared about 1930, was led to state, "Correctness of record extremely doubtful." Considering that the nearest authentic specimen available to him was from the St. Clair River at Point Edward, Malte's suspicion was justified at the time.

In 1952, plants were collected near Bourget at a site where *Zizania aquatica* var. *aquatica* and *Phragmites communis* are also localized. The label data read: "*Echinochloa walteri* (Pursh) Nash. On muddy flood-bank of Cobb Lake (a fluctuating expansion of a slow stream entering South Nation River), 2.5 miles east of Bourget, Russell County, Ontario. Several plants seen at this the only station in Ontario east of Lake Erie. September 8, 1952. W. G. Dore and W. J. Cody No. 14048." Since this site is but ten miles due north of Casselman, the old Fletcher record is presumed to be correct.

Another Ontario record unsubstantiated by specimen, "In alluvium along the Salmon River, above Shannonville, Hastings County, Ontario (Macoun)", remains in need of investigation. — W. G. DORE, *Division of Botany, Department of Agriculture, Ottawa*.

<sup>1</sup> Contribution No. 1243 from the Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Canada.

#### DOES THE SCHEFFER MOLE DRINK? —

After 15 years study of the habits of the Scheffer mole *Scapanus orarius schefferi* Jackson, in the coastal areas of southern British Columbia, its need for drinking water cannot be decided. That it can, and does go for periods of several weeks without drinking, has been proved with many individuals kept up to three months in soil cages and fed earthworms. Tins of water placed in the cages were not used apparently, but were filled with soil repeatedly. Scheffer however records that the common eastern mole *Scalops aquaticus* L. drank eagerly under similar conditions, putting their snouts into the water in the manner of hogs.

Under natural conditions in the field during long dry summers, no surface water is available without long overland journeys which are most unlikely, also no footprints

have ever been seen in the marginal mud of ponds. Dew could supply the moisture required, but at Agassiz periods of low humidity occur when continental air-masses move westward, and no dew dampens the grass.

It is possible that sufficient water is obtained from earthworms which comprise 99 percent of the Scheffer moles' diet; the earthworms themselves containing approximately 90 percent water.

W.H. Hudson, the incomparable observer and recorder of nature wherever he happened to live, discussed the matter of drinking by the European mole, *Talpa europea* L. in his book "Nature in Downland". He was convinced apparently that moles had to drink, and wondered how the mole population inhabiting the high and dry chalk downs of southeast England found sufficient moisture to survive during hot rainless periods in summer. He states that he had been taught that moles must drink often or at regular intervals, and drink deeply, but does not give the source of this idea. He also states that to satisfy their thirst they make runs to the nearest water-courses, and that when none is available they sink a well. As no water-courses are present on the tops of chalk downs, and subterranean water would be very scarce and deep in that porous rock, Hudson failed to see how wells could be sunk in such material.

Hudson's doubts were confirmed by talks to shepherds and other regular frequenters of these arid South Downs. These observers are recorded as having found "a good many moles lying about dead on these hills every morning" — "in very dry windy summers when there is no dew". This chapter (5) of Hudson's delightful book is well worth reading again.

Coming back to the Scheffer mole of the humid Pacific slope, we still do not have any clear evidence for or against drinking. However in May 1950, an extremely interesting fact on the tunnelling habits of this species was accidentally discovered, though at the time of observation and recording, its possible connection with drinking habits was not realized.

At that time a new well was being sunk on the Experimental Farm here, when at a depth of 7 feet a mole tunnel was disclosed running diagonally from one side of the 6 foot-wide shaft to the other, and even as



the workmen dug, a mole came out of the tunnel, fell into the bottom on the mud and was despatched and thrown out by the workmen. I confirmed the presence of the tunnels, their depth and the species of mole. The sandy alluvium was saturated with water at this depth, and baling was necessary to continue digging. The comparatively high water table at the site of the well is due to the Fraser river freshet at this time of year, and the close proximity of subterranean gravel bars extending from the river.

At the time no reason could be ascribed for such a deep tunnel. The subsoil at that depth is quite without humus and no earthworms or other life forms suitable for mole food occur. Earlier investigations on the depth of tunnels had shown a series of runways at a depth of from 3 to 3½ feet, no deeper, in sandy well drained land at Agassiz. These tunnels might provide some food during dry spells but were thought to have been dug by moles to avoid the frost line, though at Agassiz this does not as a rule ever go below 1½ to 2 feet. The usual depth of the hunting runs are from 6 to 8 inches in winter, while in summer surface runs without "hills" are most common.

The thought therefore occurs that this 7-foot deep runway might have been dug to reach water, and would provide drinking facilities during the hot dry dewless periods in summer. So possibly Hudson's information was sound after all.

Summarizing, it can be said that under normal conditions in the Lower Fraser valley the Scheffer mole obtains sufficient moisture from its natural foods or from the rain-wet grass or dew. It is much too dangerous for it to drink at any surface water in ponds or streams. In dry spells, when even earthworms, now with lower water content, fear desiccation and tie themselves into knots, moles use these deep tunnels to quench their thirst.

If this was not the purpose of this 7 foot deep tunnel, what was it dug for? —  
R. GLENDENNING, Agassiz, B.C.

**An addition to the list of the mammals of Nova Scotia: the Eastern Red Bat.** In October 1952 a bat was captured when it came aboard the fishing vessel "Janet Louise", out of Liverpool, N.S. and under command of Captain Warren Levy. The position of the ship at that time is reported as over 150 miles SSE of Liverpool buoy,

Latitude 42°42' N, Longitude 62°58' W. It was believed by the ship's crew that the bat may have been driven out to sea by strong winds. The date of capture is placed by the writer as on or about October 7.

The bat died in captivity shortly after being brought to shore and was put in the freezer of Nickerson Bros. Limited at Liverpool. In a letter to the writer, Mr. J. F. Donly of Mill Village, N.S. requested identification of the bat and enclosed a brief description. The specimen was sent to the writer after subsequent correspondence with Mr. R. M. Nickerson.

The bat was identified by the writer as the Eastern Red Bat, *Lasiurus borealis borealis* (Müller). A study skin was made of this specimen, which is No. 1533 in the writer's collection. Details of measurements, etc. as taken after the specimen was thawed out are as follows: sex — female; length — 112 mm.; 'wing' — 132+ mm.; tail — 58 mm.; hind foot — 9 mm.; forearm — 41 mm.; thumb — 7 mm.; tragus — 6 mm.; ear past nose — 1.5 mm.; ear from meatus — 11 mm.; ear from crown — 8 mm.; stomach — not examined.

Smith (1940) does not mention this species in his list of Nova Scotia mammals and Anderson (1946) does not include Nova Scotia in the range of the species. Morris (1948), in his list of New Brunswick mammals, mentions the one existing Nova Scotia record of the closely-related Hoary Bat, *Lasiurus cinereus* (Beauvois) but no reference is made to the Red Bat in Nova Scotia.

The specimen described above apparently constitutes the first record of the occurrence of the Eastern Red Bat in Nova Scotia.

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**Northern extensions of range of some  
repnant decapod crustacea of British Colum-**

**bia.** — Of recent years the staff of the Provincial Museum of British Columbia has made a number of small shore collections of decapod crustacea in conjunction with a study of the fauna and flora of various coastal islands. In these collections three species have been found in a more northerly location than had been previously recorded. A fourth species, new to the Province, has been found on the south-east coast of Vancouver Island by the author.

A porcelain crab, *Petrolisthes eriomerus* Stimpson, was previously recorded from Flamingo Harbour, on the south-west tip of Moresby Island of the Queen Charlotte group (Josephine F. L. Hart. "Reptant decapod crustacea of the west coasts of Vancouver and Queen Charlotte Islands, British Columbia" Canadian Journal of Research, D, 18:86-105. 1940). On May 24, 1952, six specimens were taken on Langara Island, some 140 miles farther north.

Another species of the same family, *Pachycheles pubescens* Holmes, was taken in 1948 at Goose Island, about 52° north latitude. The former northern limit was Esperanza Inlet, Vancouver Island (Hart *ibid*). At Goose Island also was found a spider crab, *Pugettia richii* Dana. This species too had been found previously as far north as Esperanza Inlet (Hart *ibid*).

The pea crab, *Pinnixa eburna* Wells, was originally found and described from San Juan Island, Puget Sound, Washington. This species lives as a commensal in the burrows of the lug worm, *Arenicola pusilla* Quatrefages. During the spring of 1952, it was found to occur near Victoria, at Oak and Cordova Bays, which extends its known range slightly northward and across the International Border adding another species to those crabs previously reported from British Columbia. — JOSEPHINE F. L. HART, Volunteer Assistant, Provincial Museum, Victoria, B.C.

**Wilson's Petrel**, *Oceanites oceanicus oceanicus* (Kuhl), at **Lake Deschenes, Quebec.** — While checking pelagic birds in the National Museum collection, Ottawa, with Mr. W. Earl Godfrey we found an unrecorded specimen of Wilson's Petrel. This specimen is a female taken on the Quebec side of Lake Deschenes

near Ottawa on September 23, 1938, after a great Atlantic storm. The specimen is number 28908 in the collection and its identification has been carefully confirmed by Mr. Godfrey. This is the first record for the Ottawa area.

Eliot (*The Auk*, 1939, Vol. 56, p. 178) published a report, which he said was passed on to him *in verbis* by Dr. R. C. Murphy, of Wilson's Petrels having been blown to Montreal by the same 1938 storm, but this apparently was a result of a misunderstanding. The National Museum files contain an excerpt from a letter written by Dr. Murphy on January 12, 1940, to the late P. A. Taverner in this connection which reads:

"It is my opinion that Eliot is in error in crediting a Montreal record to me. On the other hand, it is possible that through a slip of the tongue I said Montreal when I meant Ottawa. I evidently made the remark while chatting with Professor Eliot during a visit to Smith College and my authority was from a communication from you that a Wilson's Petrel had been collected on Lake Deschenes on September 23, 1938."

Apparently, then, the Montreal report was incorrect and the Lake Deschenes specimen seems to be the first valid record for the Quebec interior. From Ontario there appears to be only one valid record: a specimen found dead at Lake Muskoka as recorded by Fleming (*The Auk*, 1901. Vol. 18. p. 35). — HOYES LLOYD, Rockcliffe Park, Ont.

**California Sea Lion** (*Zalophus californianus* (Lesson)) in **British Columbia.** — The occurrence of California sea lion in British Columbia has previously been based on a single unweathered skull "picked up" at Clayoquot, Vancouver Island, British Columbia, by Capt. Hughes, (Cowan, I. McT., Canadian Field-Naturalist Vol. L, pp. 145-148, December 1946). This questionable record has been validated by the appearance of two large bulls near Ucluelet, British Columbia in February, 1953. The skull of one of these animals was subsequently collected for the Provincial Museum by Mr. George Hillier of Ucluelet, and is now in the museum collections. — C. J. GUIGUET, Provincial Museum, Victoria, B.C.

## REVIEWS

EVOLUTION IN THE GENUS  
DROSOPHILA

J. T. PATTERSON and W. S. STONE

*The Macmillan Company of Canada Limited,  
Toronto. 610 pp. \$8.50*

This is by no means a book for casual armchair reading, nor is it solely concerned with *Drosophila*. The former is well illustrated by the following excerpt: "The primitive II arose from I by two overlapping inversions in the sex chromosome, Xab, and this line produced *texana*, *americana*, and *nova-mexicana*. Primitive III also arose from I by two inversions in the 2 chromosome, 2de. Either d or e, which is the pericentric in 2, could have occurred first". The latter by the inclusion among the more than 700 references cited of some 70 dealing with animals exclusive of *Drosophila*, and an equal number concerned with plants. These are included to show that the systems discussed are not peculiar to *Drosophila* but are general evolutionary ones which have played their roles elsewhere.

The enormity of the task so admirably accomplished by Professors Patterson and Stone can perhaps in no way better be appreciated than by a perusal of the 37 pages of references. To point out here that there are only some 15 as recent as 1951 and 1952 (most of which are quite naturally publications from among their own group at the University of Texas) is in no sense an intended criticism — it is meant simply to emphasize the magnitude of their self-assignment. It is of interest to note, however, that more than one-half of the citations specific to *Drosophila* originated in the nineteen-forties; a truly great decade of production, including as it does the crippling war-years.

In view of the tremendous amount of labour involved in compiling and proof-reading this work, the paucity of typographical errors is surprising. There are in addition a small number of apparent slips: on p. 170, for example, in differentiating heterochromatin from euchromatin, the latter is equated with "the ordinary gene chromosome" — surely gene chromatin!

The text, which includes over 100 tables crammed with fact and 74 diagrams, maps, drawings, and photographs, is divided into eleven chapters. The problem is clearly set forth in the first, an adequate exposition of

the systematics of *Drosophila* takes up the next, and geographic distribution and relationships are dealt with in Chapter 3. Gross chromosomal evolution, as seen through visible structural alteration of metaphase configurations, is treated, in so far as is possible, separately from the more detailed information to be gleaned from analyses of salivary gland chromosomes. The comparison of metaphases brings out the important contribution made by "whole-arm" fusions, for 60 per cent of the known types show a reduction from six to five, four, or even three pairs of chromosomes. On the other hand, only one species (0.5%) is known to have an increased chromosome number. About the salivary gland work, the authors aptly remark: "These inversions and fusions (detectable in salivary gland chromosomes) are very remarkable tracers, in many ways more remarkable than the more spectacular isotope tracers of chemistry. Any chromosome arrangement that is characteristic of one or several species, but which differs from other gene orders, demonstrates that all individuals of even a tremendous species or species group descended from the one ancestor that first possessed it". What a pity for the study of phylogeny that these giant chromosomes do not occur outside of the Diptera!

Chapter 6 reviews gene variation, selection, and genic balance, while Chapters 7 and 8 deal in considerable detail with the evidence for isolating mechanisms, and the barrier they afford to gene flow between related forms. Hybrids and their sterility take up Chapter 9 and serve to point up the genetic differences that characterize related groups. Chapter 10 is devoted to origin and relationships in the virilis group, and the final one is entitled "Comparisons and conclusions".

Chapters 3 to 10 each conclude with a discussion. For those who are chiefly interested in getting an authoritative statement on the contribution being made by genetics to an understanding of evolutionary processes, they are required reading. Together with the first and last chapters, they comprise little more than one-third of the text; they are admirably written, and most assuredly will serve to whet the appetite of all but the most lackadaisical reader. To the serious student of phylogeny, the volume will be particularly valued for its lucid and

penetrating correlations; to the Drosophologist, it will doubtless soon become a well-thumbed indispensability. — S. G. SMITH.

**The Frogs, Toads and Salamanders of Eastern Canada.** By E. B. S. Logier. Clarke, Irwin and Co. Ltd., Toronto, 1952, pp. i-xii, 1-127, 5 plates, 57 drawings. \$3.75.

This is the first book of its kind that is strictly Canadian and its author may be justly proud. The need for a volume concerning the amphibians in Canada has been obvious to many. By providing an introduction to the amphibians as a group and presenting up to date and accurate information on our twenty-six eastern Canadian species, this book seems designed to answer those many questions with which teachers, camp directors and museum staffs are so often confronted.

Mr. E. B. S. Logier has been on the staff of the Royal Ontario Museum of Zoology and Palaeontology for thirty-five years where he is now Associate Curator of the Division of Ichthyology and Herpetology.

It is a pleasure to read Mr. Logier's precise and accurate yet flowing style. Exceptions to statements and further detail are neatly enclosed in brackets or foot-notes eliminating the pitfall of so many popular works where accuracy is sacrificed for generalizations. The author's excellent illustrations enhance the value of the book and it is noteworthy that they appear on the same page with the text which refers to them.

The whole work bespeaks organization towards making it readable and informative. The first fifty-seven pages are intended to acquaint the reader with the amphibians, their past and present relationships. Their anatomy including skin shedding and regeneration, their senses, instinct and intelligence. The rest of this excellent section concerns life histories, the effect of temperature and moisture on the distribution of amphibians, an emphatic and worthy discourse on economic importance and conservation, and finally "Some Technical Procedures", wherein methods of collection, measuring, sexing and recording are explained with the aid of

drawings. This last chapter deserves the highest praise for Mr. Logier emphasizes the importance of stating precisely how measurements were taken, since such terms as "foot length" and "leg length" used by many authors can mean any of several measurements. The lack of standardization in herpetological methods is at times disheartening.

The rest of the book contains keys to and descriptions of our eastern Canadian species. The keys are accompanied by detailed drawings which are indeed welcome crutches to those who are stumbling for their first time through a "Key to Species". Each species discussion is provided with a drawing of the animal. The species are rather thoroughly covered under the headings Range, Distribution in Eastern Canada, Size and Structure, Colour, Habits and Habitats. In addition the tadpoles of many species are described. Colour descriptions and distributional data will be of especial interest to students of herpetology. Mr. Logier's views on the wood frog subspecies complex are heartily agreed with by the reviewer.

The book concludes with a nine page Glossary, a Bibliography in which there is an asterisk marking each of the more helpful reference books, and an index.

The reviewer has only a few criticisms. No mention is made of the distinct dark edge characteristic of the spots on the back of the Fowler's Toad. In the drawing of the wood frogs (opposite page 108) the individual best depicted (foreground) is the form least likely to be seen by Canadians in southern Ontario, Quebec and the Maritime Provinces. The stark plate of the mink frog is not in keeping with the rest of the book. Finally, had the distributional descriptions been presented as blackened areas on small outline maps of eastern Canada the value of the book would be further enhanced for such maps published thus far have been most inaccurate. However, these are minor criticisms and should certainly not deter one from reading this excellent contribution to our knowledge of Canadian vertebrate faunas. — SHERMAN BLEAKNEY.

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NOV 9 1953

Published by the  
OTTAWA FIELD-NATURALISTS' CLUB

Authorized as second class mail, Post Office Department, Ottawa.



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# The Canadian Field-Naturalist

Vol. 67

OTTAWA, CANADA, OCTOBER-DECEMBER, 1953

No. 4

## A COMPARATIVE STUDY OF ADULTS OF TWO CANADIAN RACES OF RED-WINGS<sup>1</sup>

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*Royal Ontario Museum of Zoology and Palaeontology, Toronto.*

NOV 30 1953

### Introduction

TWO RACES of the Red-wing, *Agelaius phoeniceus*, are recognized in Canada east of the Rockies, *A. p. arctolegus* and *A. p. phoeniceus* (see 1931 edition of the A.O.U. Check-List). The present study is an evaluation of the taxonomic characters of these forms as displayed by adults, an exposition of their variability, and the determination of the geographic boundaries of the races in Ontario.

The race *A. p. arctolegus* was described by Oberholser (1907) who reallocated the application of the name *A. p. fortis* of Ridgway (1901) and restricted the latter to the population occupying the southern Great Plains. Concomitantly he applied the new name to the population occupying the northern Great Plains from Montana (and northern Michigan) north to Mackenzie and Keewatin. After distinguishing *A. p. arctolegus* from *A. p. fortis* Oberholser stated that the former is much like the nominate race in colour, males being practically indistinguishable and females barely less blackish above and below. However, with respect to size, he points out that *A. p. arctolegus* is much larger.

### Specimens and Procedure

In the present study a selection of specimens from the collection of the Royal Ontario Museum of Zoology and Palaeontology was made to eliminate transients and immatures. Specimens taken prior to May 24 or after August 16 in southern areas were excluded. Thus the southern material used in all probability represents adults established within their normal breeding zone. A few specimens collected on earlier and later dates from northerly areas were permissible since they were obviously in their breeding zone. Actually all but a few were collected

from breeding colonies during the months of June and July. The selected series comprised a total of 176 specimens representing both populations, 110 adult males and 66 apparently adult females.

A preliminary sorting of specimens according to size, using as a guide both the measurements of Oberholser and those obtained from specimens taken in the heart of the range as ascribed to the two forms, developed a geographic boundary between them in central and northern Ontario. It became obvious that specimens from northern Ontario as far east as James Bay were referable to the larger form of the west. The collection divided into 103 specimens representing a northern and northwestern race and 73 representing the more southern and eastern race. Both the number of specimens and their geographic representation are considered adequate and satisfactory to reveal the range of variability of the two populations.

Measurements of seven characters were used for comparison. Linear measurements here presented are in millimeters and weight measurements are in grammes. Total length, wingspread and weight measurements are those of the collector as recorded on specimen labels. All other measurements were taken by the authors. The wing length and culmen length represent the chord of these members. The depth of bill measurement was taken as the vertical height through the nostril. As will be noticed in table 1, the number of measurements of some characters is less than the total of available specimens. This is owing to incomplete data on specimens or, in some cases, to damaged parts.

Statistics of size variation presented as part of table 1 are graphically presented in figure 1. The central horizontal line in the graph represents the arithmetic mean; the

<sup>1</sup> Received for publication August 27, 1952.

Table 1. Statistics of size variation of specimens of *Agelaius phoeniceus arctolegus* and *A. p. phoeniceus*.

♂ ♂ FEATURE	RACE	NO. OF SPECIMENS	OBSERVED MINIMUM- MAXIMUM	ARITHMETIC MEAN	STANDARD DEVIATION	MEAN $\pm$ 2S	STANDARD ERROR	MEAN $\pm$ 2 SE
Wing	arctolegus	66	119-131	125.7	2.58	120.5-130.9	.32	125.1-126.3
	phoeniceus	44	116-126	121.3	2.77	115.8-126.8	.42	120.5-122.1
Tail	arctolegus	66	84.5-96.5	90.1	3.29	83.5-96.7	.40	89.3-90.9
	phoeniceus	44	81.5-95	88.4	3.46	81.5-95.3	.53	87.3-89.5
Culmen	arctolegus	65	22-26	24.3	.92	22.5-26.1	.12	24.1-24.5
	phoeniceus	42	21-26	23.2	1.06	21.1-25.3	.16	22.9-23.5
Depth of Bill	arctolegus	66	10-12.8	11.1	.56	10.0-12.2	.06	11.0-11.2
	phoeniceus	44	9-11	10.0	.55	8.9-11.1	.08	9.8-10.2
Total	arctolegus	42	225-252	237.6	7.79	222.0-253.2	1.21	235.2-240.0
Length	phoeniceus	33	218-247	231.6	7.21	217.2-246.0	1.27	229.1-234.1
Wing- spread	arctolegus	20	376-409	395.1	8.66	377.8-412.4	2.0	391.7-399.1
	phoeniceus	12	364-402	383.0	13.28	356.4-409.6	4.0	375.0-391.0
Weight	arctolegus	13	62.5-75	70.4	5.22	60.0-80.8	1.50	67.4-73.4
	phoeniceus	10	58.5-74	66.2	5.36	55.5-76.9	1.78	62.6-69.8

♀ ♀								
Wing	arctolegus	37	99-109	104.0	2.54	98.2-109.8	.42	103.2-104.8
	phoeniceus	29	95-105	100.5	2.38	95.7-105.3	.45	99.6-101.4
Tail	arctolegus	37	68.5-80	73.2	3.09	67.0-79.4	.51	72.2-74.2
	phoeniceus	29	67.5-78.5	73.1	2.91	67.3-78.9	.55	72-74.2
Culmen	arctolegus	37	18-21	19.8	.81	18.2-21.4	.13	19.5-20.1
	phoeniceus	29	17.5-20	19.1	.73	17.6-20.6	.11	18.9-19.3
Depth of Bill	arctolegus	36	8.5-11	9.3	.50	8.3-10.3	.08	9.1-9.5
	phoeniceus	28	7.5-8.9	8.2	.34	7.5-8.9	.07	8.1-8.3
Total	arctolegus	25	189-216	201.2	5.27	190.7-211.7	1.07	199.1-203.3
Length	phoeniceus	23	188-209	199.3	5.45	188.4-210.2	1.16	197.0-201.6
Wing- spread	arctolegus	13	320-336	327.6	4.84	317.9-337.3	1.40	324.8-330.4
	phoeniceus	12	305-329	317.5	7.84	301.8-333.2	2.36	312.8-322.2
Weight	arctolegus	12	37-52	45.9	4.94	36.0-55.8	1.49	42.9-48.9
	phoeniceus	5	40-49	44.6	4.04	36.5-52.7	2.02	40.6-48.6

vertical box, two standard errors; the vertical line two standard deviations; and the crosses indicate observed minima and maxima.

Average pattern, tone and colour differences exist between females of *A. p. arctolegus* and *A. p. phoeniceus*. The former is inclined to exhibit with greater frequency pinkish on the throat which character often extends to the upper breast. Also, as pointed out by the describer, females of *A. p. arctolegus* tend to be less blackish above and below. The dark pigment in the stripes of the ventral feathers is frequently more dilute, i.e., paler in tone. In this respect females of *A. p. arctolegus* tend slightly toward *A. p. fortis*. Furthermore, females of *A. p. arctolegus* tend to be less blackish below owing to some restriction of the dark stripes and a cor-

responding widening of the white markings. A measurement of this feature has been carried out as follows:

A standard of four grades was selected from the total series of 66 adult females representing both races. These arbitrary grades were carefully adjudged to represent approximately equal steps. Grade one represents cases in which dark markings of the ventral surface are broad, exceeding white markings. Grade four represents cases in which white predominates. Grades two and three represent intermediate conditions.

Each individual specimen in the whole series of females was compared with the selected standard and scored accordingly. The tendency of *A. p. arctolegus* females to be

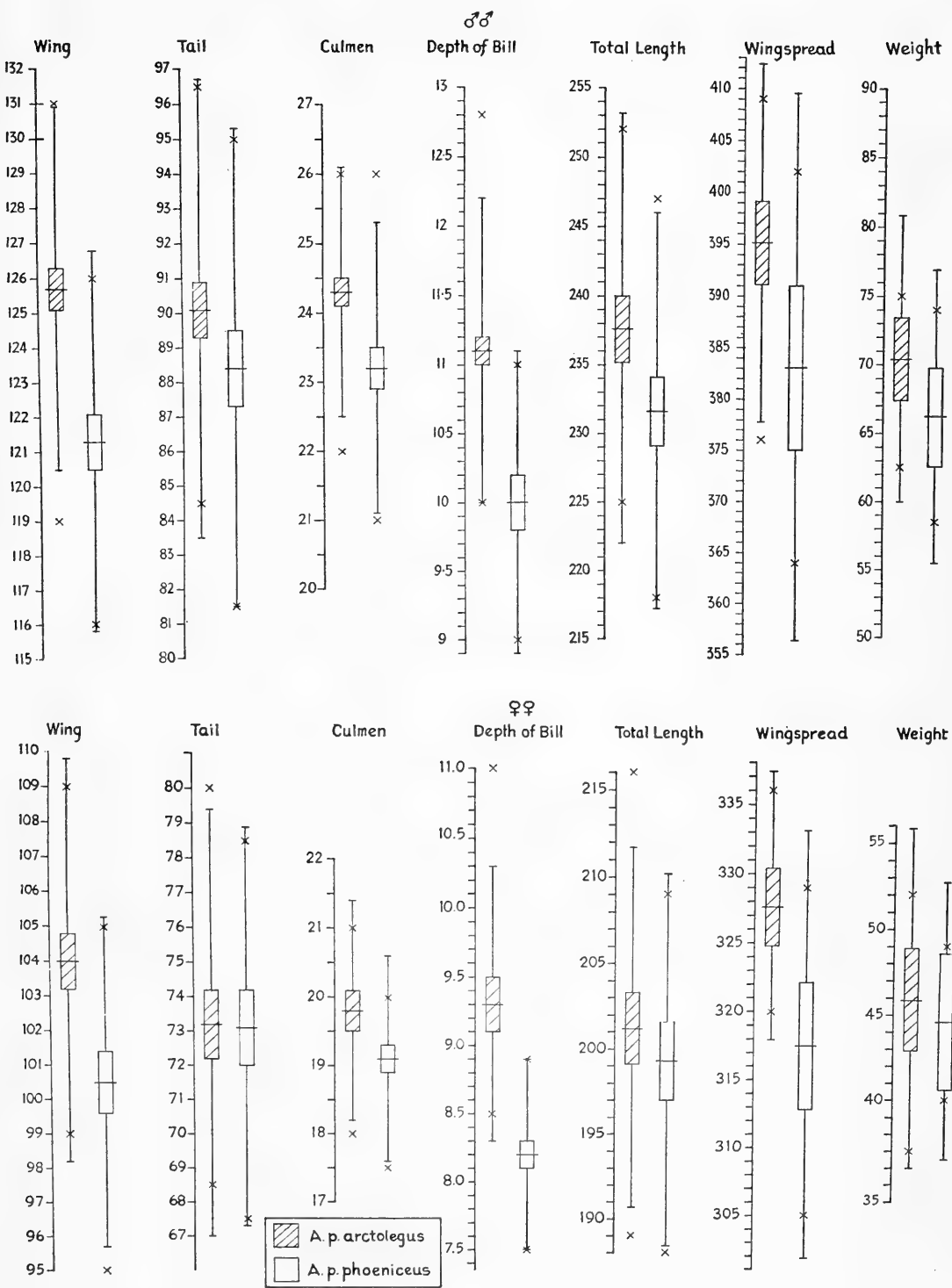


Fig. 1. Size variation in *Agelaius phoeniceus* *arctolegus* and *A. p. phoeniceus*.

Table 2. Colour differences between ♀♀ of *A. p. arctolegus* and *A. p. phoeniceus*.

Grade	← Predominance of black		→ Predominance of white	
	1	2	3	4
% of 37 ♀♀ <i>arctolegus</i>	2.7	27.0	59.5	10.8
% of 29 ♀♀ <i>phoeniceus</i>	17.3	44.9	37.8	0

generally lighter ventrally and *A. p. phoeniceus* to be darker is revealed by the percentage figure in Table 2.

Figure 2 presents the geographic phase of the present study. The solid and open circles on the map indicate the places from which specimens used originated. The boundary limits of the two recognized races in Canada east of the Rockies are indicated by lines. Suitable ecological conditions for this species occur rarely on the pre-Cambrian shield determining the rarity or sporadic distribution of Red-wings in the more northerly districts of Ontario, and in part account for the complete lack of specimens in the area between the lines demarcating racial limits. Specimen material from the Province of Quebec is needed in order to complete and refine the distributional picture there.

### Discussion

Our comparison of a satisfactory sample of two populations of Red-wings from east of the Rockies in Canada show that the most significant size differences and useful diagnostic characters concern two appendages, namely, length of wing and vertical thickness of the bill at, (or near) the base. This applies to both sexes. In addition, there is a significant average difference in length of the culmen in both sexes. Other measurements involving the bill and wing, i.e., total length and wingspread, show average differences in males. There is no significant difference in total length measurements of females but their wingspread difference is significant. Length of tail and weight measurements show no significant difference in either sex.

Details of distribution of the longer winged, thicker billed, western race, *A. p. arctolegus*, are of particular interest. As stated, specimens from western and northern Ontario, east to James Bay, are clearly related to the western population. This

affinity of northern Ontario faunal elements to western faunas is a point previously mentioned in the literature (Snyder, 1928, p. 5; Snyder, 1935, p. 62-63) and the suggestion that this zoogeographic pattern is linked with redistribution following glaciation has been made (Snyder, 1939, p. 6). The present study has indicated a boundary between races of Red-wings in Ontario which extends from the northeast shore of Lake Superior northeastward to the tip of James Bay. This boundary approximates, parallels, or corresponds to a number of zoogeographic boundaries which are known, some of which have not been discussed in the literature. Thus this regional study of the Red-wing adds supporting evidence to the hypothesis that faunas from two directions have converged in their reoccupation of northeastern North America following glacial retreat, one moving into northern Ontario from the west and southwest, and the other from the south and east, thus converging north of the Great Lakes.

It has been remarked that Red-wing colonies are relatively scarce in much of the region covered by the Pre-Cambrian Shield in Ontario. The slow disintegration of hard rock is not conducive to the development of silted basins and marsh situations which constitute optimum ecological conditions for the species. However, the absence of specimens in the Museum's collection from the area between the lines marking limits of range of the two races of Red-wings in Ontario does not mean the species is unrepresented there since there are sight records at Chapleau (Baillie and Hope, 1947, p. 27) but it is rare. It is possible that the nominate race has extended its range northward in comparatively recent times with the removal of much of the forest about settlements, especially in the clay belt of the central east. Finally, the recognition of *A. p. arctolegus* in northern Ontario east to James Bay tends to explain occurrences of

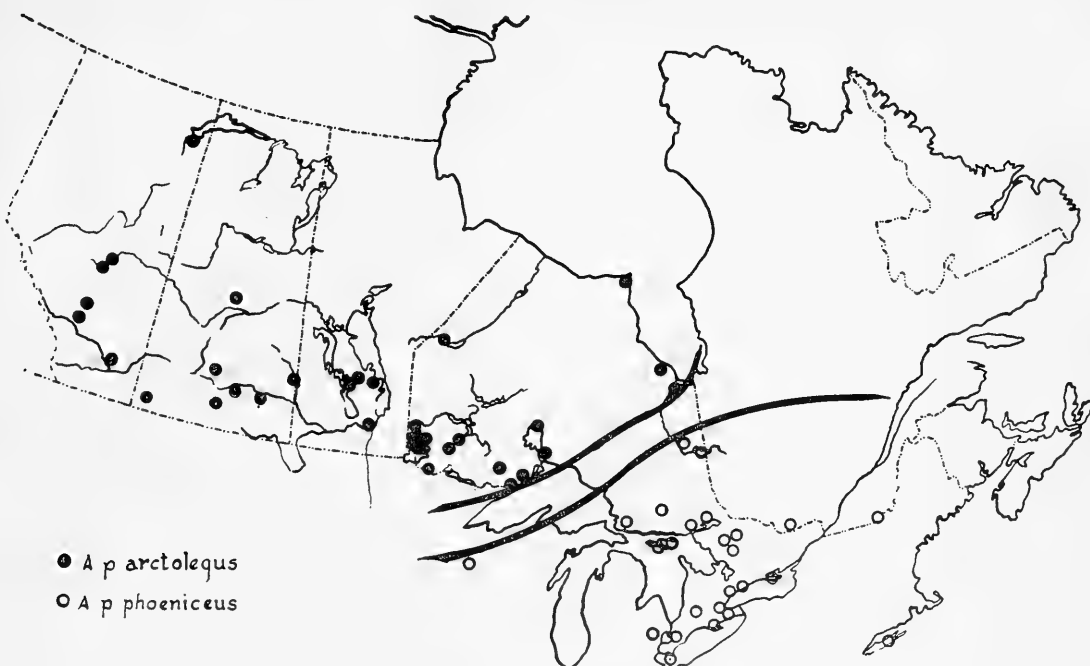


Fig. 2. Distribution of specimens of *Agelaius phoeniceus* examined.

this form as a transient in Michigan (Van Tyne, 1938, p. 36), New York and Connecticut (Brodkorb, 1937) and probably other eastern localities.

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BIRDS OBSERVED ON A CANOE TRIP IN NORTHERN MANITOBA<sup>1</sup>

WILLIAM F. DAVIS

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DURING the summer of 1951, my ambition of several years' standing — to make a canoe trip from Lake Winnipeg to Hudson's Bay in northern Manitoba, Canada — was finally realized. While the major objective of the trip was simply to see the northern wilderness, I took careful notes on the bird life along the way.

The most recent list of the birds of this area was published in 1902 as a result of a general biological investigation made of the region immediately west of Hudson's Bay by Edward A. Preble of the Bureau of Biological Survey in 1900. As might be expected, numerous changes have occurred during the 51-year interval. Fifteen species here reported were not recorded by Preble on the portion of his trip from Selkirk to York Factory, and the status of many others in this area has apparently changed. Unfortunately, many birds were missed on this trip due to my scanty knowledge of bird songs. I was also handicapped by an inability to discern red in certain shades or under certain light conditions. As a result, I was never able to distinguish between Common and Arctic Terns (*Sterna hirundo* and *S. paradisaea*) since their bills looked uniformly dark with no trace of red.

I left Selkirk, Manitoba, a few miles north of Winnipeg on the Red River, aboard the *S. S. KEENORA* on the fourth of June for the 350-mile trip down the Red River and up Lake Winnipeg to Norway House, a Hudson's Bay Post situated on Little Playgreen Lake about 20 miles north of Lake Winnipeg. En route to here, stops were made at Matheson Island and Berens River along the way, and at Warren's Landing at the northern end of the lake.

In the company of an Indian guide I left Norway House on June 8 and followed the long-travelled Nelson-Echimamish-Hayes River route to York Factory, a Hudson's Bay Post at the mouth of the Hayes River on Hudson's Bay. Little Playgreen, Hairy, Robinson, Logan, Max, Opiminegoka (Pine), Windy, Oxford, Back, Knee and Swampy Lakes were successively crossed in that order on the way to the Bay. At the Hudson's Bay Post on

Oxford Lake I left my first guide and engaged another who took me down the Hayes River to within 110 miles of York Factory, from which point I proceeded on alone, arriving at the Bay June 18 after a trip of 375 miles from Norway House. With the exception of the portion of the route through Max Lake, which the guide insisted we follow to avoid a rapid-filled section of the Hayes River, I took the exact route taken by Preble to York Factory. In his report, confusingly enough, the various sections of the Hayes River between lakes all have different names.

Paddling was the means of propulsion to Oxford House, but my second guide had a motor which we used until I left him and resumed paddling to York Factory.

I joined a party of three Indians with a "kicker" June 20 at York Factory and accompanied them around the narrow peninsula separating the Hayes and Nelson Rivers at this point, up the Nelson about 45 miles to the mouth of the Weir River, and along the tortuous path of the latter stream to the Hudson's Bay Railway.

After spending one day in Churchill, Manitoba, at the northern terminus of the railway, I made my way by train to Thicket Portage, 189 miles south of the Weir River intersection. From this point I planned to return to Norway House by canoe, but after travelling 20 miles east through Landing Lake, Sabomin Lake, and over the two-mile Cross Portage to Sipiwesk Lake it was found that the lake and the ensuing stretch of the Nelson River which I would have to traverse were too high and swift for one man to paddle alone, so I was forced to retrace my route to the railway and return to Winnipeg by train.

Except for a strip of Silurian sediments along the coast of Hudson's Bay, the entire route lay across the Pre-Cambrian rocks of the great Canadian Shield. Bare rock was exposed in varying degrees along the way, but the layer of soil was generally thin, and trees sometimes grew on nothing more than a layer of moss and the merest trace of soil overlying the bed-rock. The country was low and rolling or with moderate ridges.

<sup>1</sup> Received for publication August 5, 1952.



The banks of the waterways were generally rocky, and low to moderate until the lower Hayes and Nelson Rivers were reached. Here, high, steep clay banks, both wooded and bare, put in their appearance.

The cover consisted of white and black spruce (*Picea glauca* and *P. mariana*), balsam poplar (*Populus tacamahaca*), jack pine (*Pinus banksiana*), white birch (*Betula papyrifera*), tamarack (*Larix laricina*), balsam fir (*Abies balsamea*), willows (*Salix* sp.), and alders (*Alnus* sp.). Northward, the spruce becomes progressively more numerous, and on the lower Hayes and Nelson Rivers the forest is composed almost entirely of stunted spruce. Vast burned areas in varying degrees of reforestation occur throughout the region and lend a desolate touch to the scene. Preble (1902) states that the transition from Canadian to Hudsonian zone occurs on the eastern shore of Swampy Lake.

My list of birds does not include those seen at Churchill during the single day I was there, since Taverner and Sutton (1934), and various others, including Allen (1946), have covered the area quite thoroughly. However, since the above papers do not mention them, I do want to note the occurrence of a small flock of Rock Doves (*Columbia livia*) in the rail yard, by the roundhouse. A few House Sparrows (*Passer domesticus*), as well as several Song Sparrows (*Melospiza melodia*), were seen and heard around the town, and a few Tree Swallows (*Iridoprocne bicolor*), were also noted.

I should like to express my thanks to Dr. George J. Wallace of Michigan State College for his generous aid and advice in the preparation of this paper.

An annotated list of the birds seen on the trip follows.

**Common Loon.** *Gavia immer*. With the exception of the lower Hayes and Nelson Rivers and the Weir River, loons were seen along the entire canoe route. They were especially common on the larger lakes, and the greatest numbers were seen during sessions of evening paddling.

**Holboell's Grebe.** *Colymbus grisegena*. This species was first met with on the Nelson River below Little Playgreen Lake. One was also noted and one was heard on Hairy Lake, an enlargement of the Echimamish River a few miles above its mouth, five on the Hayes River below Painted Stone Portage, three

on the Hayes between Robinson Lake and Robinson Falls, two on Knee Lake, and two on the Hayes River below the outlet of Swampy Lake. This species was not reported by Preble.

**White Pelican.** *Pelecanus erythrorhynchos*. A few were noted on the Red River north of Selkirk in a broad lake-like area.

**Double-crested Cormorant.** *Phalacrocorax auritus*. A cormorant was seen between Lake Winnipeg and Norway House, two more on the Nelson River between Little Playgreen Lake and Sea River Falls, about twenty miles north of Norway House, and one on the Hayes River some distance below Swampy Lake. Preble saw one on Pine Lake on his southward trip in September.

**Great Blue Heron.** *Ardea herodias*. Two were seen flying along the bank of the Red River below Selkirk.

**Black-crowned Night Heron.** *Nycticorax nycticorax*. Many night herons were observed along the banks of the Red River north of Selkirk. This species was not seen by Preble.

**American Bittern.** *Botaurus lentiginosus*. At Norway House I was surprised to hear the pumping call of the bittern emanating from a bog in a dense spruce woods not far from the lake. Several bitterns were calling from a marsh bordering the Hayes River below Opiminegoka Lake, and a few were heard in riverside marshes below Swampy Lake. On the return trip one was flushed from a marsh near Sabomin Lake.

**Canada Goose.** *Branta canadensis*. The waterfowl-barren Weir River yielded the only geese seen on the entire trip. Three single adults and a pair of adults with five well-advanced goslings were noted on June 21.

**Mallard.** *Anas platyrhynchos*. A pair of mallards was first seen at Norway House, and many were noted on the Nelson River between Little Playgreen Lake and the Echimamish River. This locality yielded more mallards than any other of the entire trip, although a few were seen in most lakes and stretches of the Hayes River until a point a short distance below the outlet of Swampy Lake was reached. The mallard was not observed during the rest of the trip, even in the Landing Lake area where more suitable habitat was encountered. Of course, the Pre-Cambrian area of Canada is not noted for its waterfowl populations.

This duck has increased considerably since Preble's trip, very likely because the natives

are being educated to forego the killing of waterfowl until after the breeding season.

**Pintail.** *Anas acuta*. Only one pintail, a male, was seen during the entire trip. This bird was noted on June 15 when it flew across the Hayes River in front of the canoe just below Swampy Lake.

**Blue-winged Teal.** *Anas discors*. Two teal were observed on the trip. One was seen on the Red River north of Selkirk on June 4, and one on the Echimamish River between Hairy Lake and Painted Stone Portage June 10. This species was not reported by Preble.

**Baldpate.** *Mareca americana*. One at Hairy Lake, one on the Hayes River below Windy Lake, a few on the Hayes below Swampy Lake, and one on the Nelson River above Hudson's Bay were my only records for this species. Preble did not record this duck.

**Ring-necked Duck.** *Aythya collaris*. A pair was noted on a pond-like expanse of the upper Echimamish, and a few were seen by an extensive marsh at the western end of Robinson Lake around the inlet of the Hayes River. Preble did not record this species.

**Canvas-back.** *Aythya valisineria*. A single pair was seen on the Nelson River below Sea River Falls on June 9. This duck was also not reported by Preble.

**Scaup.** *Aythya* sp. I made no attempt to determine the species in the scaups. These ducks were noted periodically between Norway House and the Hayes River below Swampy Lake, and a few were seen in the Landing and Sabomin Lake areas on the return trip. They were the most common duck on the Echimamish River, but ducks were generally very scarce there. Preble did not report this species south of York Factory.

**American Golden-eye.** *Bucephala clangula*. The Golden-eye is the most abundant duck of the region and was encountered continually from Lake Winnipeg to the Hayes River below Swampy Lake. It was especially numerous on the Nelson River below Norway House, and between Oxford House and the final stretch of the Hayes. Several flocks of males were noted along the way. In the stunted spruce area of the lower Hayes River only one golden-eye was seen, and but a very few were seen on the lower Nelson River. The last one noted on the trip was a single bird on the Weir River.

Hollow trees must be extremely scarce in the stunted spruce area. The guide whom I engaged at Norway House informed me

that Golden-eyes nested in hollow birch and poplar trees in that region.

**Buffle-head.** *Bucephala albeola*. Four Buffle-heads were seen on the Nelson River a few miles above the mouth of the Echimamish River, one on the Echimamish, one by the marsh at the western end of Robinson Lake, and two pairs on the Hayes River between Opiminegoka and Windy Lakes. During his return trip in September Preble noted a single Buffle-head near Swampy Lake.

**White-winged Scoter.** *Melanitta fusca*. A few scoters were observed on Back Lake, and a flock, plus several singles, on Knee Lake. Several of these ducks were last noted on the marshy-bordered stretch of the Hayes River below the outlet of Swampy Lake. This latter area, incidentally, was the last good duck breeding area passed on the way to the Bay.

**Surf Scoter.** *Melanitta perspicillata*. Several of these ducks were noted at the northern end of Knee Lake.

**American Merganser.** *Mergus merganser*. The American Merganser is the second most numerous duck of the region. It was noted regularly along the entire route with the exception of the Landing Lake area, and was most abundant on Oxford Lake. Even mergansers, however, along with all other ducks, were absent from a bird-barren stretch of the Hayes River extending from about 20 miles above the mouth of the Fox River to the mouth of God's River.

The likewise barren Weir River yielded only one pair of American Mergansers on June 22. The female was moulting her wing feathers and was unable to fly.

On the deep, rocky-shored lakes mergansers together with golden-eyes and loons comprise most of the waterfowl population.

This duck has undergone an enormous increase since 1900. Preble reported it only twice outside of Oxford Lake where he noted "several".

**Red-breasted Merganser.** *Mergus serrator*. This species was recorded at three localities only: one on the Hayes River above Oxford Lake, four on Oxford Lake, and two on Knee Lake.

**Red-tailed Hawk.** *Buteo jamaicensis*. A single pair of Red-tailed Hawks was observed soaring over the upper Echimamish River on June 10.

**Bald Eagle.** *Haliaeetus leucocephalus*. Two eagles were observed on the south shore of

Robinson Lake and an adult and immature were seen flying by the south shore of Oxford Lake.

**Osprey.** *Pandion haliaetus*. One was noted on the Nelson River above the mouth of the Echimamish, two on Knee Lake, an excited pair was observed circling and calling by their nest in the top of a dead spruce near a rapids on the Hayes River about midway between Swampy Lake and the Fox River, and one on the Nelson River a few miles above York Factory.

**Sparrow Hawk.** *Falco sparverius*. Three were seen along the Echimamish River between the Nelson River and Hairy Lake, and three along the course of the Weir River.

**Spruce Grouse.** *Canachites canadensis*. One hen with three small young able to fly, a single hen, and a single youngster also able to fly were encountered on Cross Portage June 29. Preble saw several of these birds on the way to York Factory while I saw none on this portion of the trip.

Strangely enough, not a single Ruffed Grouse (*Bonasa umbellus*) was seen or heard during the entire trip. The natives told me that they were more abundant two or three years ago.

**Willow Ptarmigan.** *Lagopus lagopus*. Although I did not see this bird, Tommy Singleton, a trapper with whom I stayed on Cross Portage, stated that the ptarmigans came to that region in large numbers during the winter. They usually stay from September until May, or until the snow leaves.

**Killdeer.** *Charadrius vociferus*. A killdeer was heard during the S. S. KEENORA's stop at Matheson Island, and a few were seen and heard at the Berens River stop. One bird was noted at Warren's Landing, at the northern end of Lake Winnipeg, and two on the grassy, open area behind the Oxford House Hudson's Bay Post. This species was not reported by Preble south of York Factory.

**Wilson's Snipe.** *Capella gallinago*. A single snipe, looking very much out of place perched in a tree, was seen along the course of the Echimamish River on June 9. Preble saw several of these birds in September on his return trip.

**Spotted Sandpiper.** *Actitis macularia*. This sandpiper was numerous during the entire trip, and was seen and heard almost continually except during the ascent of the Echimamish River when they became rather scarce, prob-

ably due to the thick growth of willows, sedges, etc. on the low soil banks of the stream. This species was about the only bird, with the exception of the robin, which was seen on the above mentioned barren stretch of the lower Hayes River and was more abundant here than at any other point on the trip.

For a vertical distance of about six or eight feet from the summer water level the banks of the Hayes in this area are well cleared of all woody vegetation due to the scouring action of the ice.

The Spotted Sandpiper was last noted on the Weir River.

**Eastern Solitary Sandpiper.** *Tringa solitaria*. A lone bird was noted at one of the dams on the Echimamish River June 10.

**Herring Gull.** *Larus argentatus*. With the exception of the Echimamish and Weir Rivers and the barren stretch of the Hayes River previously mentioned, where only two were seen, the Herring Gull occurred in moderate numbers along the entire route. On June 16 a nest with two downy young was found on a rock below a rapids in the Hayes River north of Swampy Lake.

**Ring-billed Gull.** *Larus delawarensis*. Even allowing for a high percentage of these birds being overlooked, the Ring-billed Gull was decidedly uncommon in the area travelled. One was noted at Matheson Island, several on the trip from Lake Winnipeg to Norway House, one at Norway House, one at Hairy Lake, and a few on a small unnamed lake between Landing and Sabomin Lakes on the return trip. Preble reported this species as common between Norway House and the Bay.

**Bonaparte's Gull.** *Larus philadelphia*. Few were seen on the trip. One was observed over a burn by the Echimamish River, a few on Knee Lake and the Hayes River below Swampy Lake, and several on the Hayes a short distance above York Factory.

**Common and Arctic Terns.** *Sterna hirundo* and *S. paradisaea*. Terns were noted during most of the trip, but due to my partial color blindness I was unable to identify them as to species. They were not as abundant as I expected them to be on the many lakes along the route.

**Black Tern.** *Chlidonias nigra*. Black Terns were abundant between Selkirk and the marshy-bordered stretch of the Hayes River below the outlet of Swampy Lake. They were particularly numerous in marshy areas, and

the extensive marsh at the western end of Robinson Lake where the Hayes River enters contained several thousand of these birds. None were noted on the Nelson and Weir Rivers or on Landing Lake.

This species was apparently more numerous than during Preble's trip, as he noted their abundance at only two points along the route.

**Nighthawk.** *Chordeiles minor*. Two were seen at Norway House and a considerable number were noted over a burn by the Echimamish River. The species was heard at Logan, Max and Knee Lakes, and a few were noted on the Hayes River below Swampy Lake, along the course of the Weir River, and at Thicket and Cross Portages. They are partial to burns.

**Belted Kingfisher.** *Megaceryle alcyon*. The first of these birds was observed at Sea River Falls on the Nelson River about twenty miles below Norway House, one on the Echimamish, two on Max Lake, two on Oxford Lake, three on the Hayes River below Swampy Lake, and one just above York Factory. A single kingfisher was noted on Landing Lake. The species has presumably decreased since Preble's trip.

**Flicker.** *Colaptes auratus*. Flickers were seen and heard occasionally from Norway House to the lower Hayes River above the mouth of the God's River, and three more were observed and one heard on an extensive burn on the Weir River. They apparently frequented the few large trees left standing after the fire.

**Pileated Woodpecker.** *Dryocopus pileatus*. One Pileated Woodpecker was seen in flight and another was heard on Robinson Lake. Their workings were seen in the base of a dead spruce by Robinson Portage, below Robinson Lake, and a few were heard at Thicket Portage, Landing Lake and Cross Portage. Tommy Singleton told me that they often become a nuisance near Cross Portage by pecking holes in the cabin logs. Sometimes the holes go completely through the wall, necessitating repairs. Preble did not note this bird.

**Eastern Kingbird.** *Tyrannus tyrannus*. A kingbird was noted by the Red River below Selkirk, one at Berens River, and one was seen in a marsh on the Echimamish River above the fourth dam. Kingbirds were extremely abundant along the Hudson's Bay Railway between Cormorant Lake and The Pas, northwest of Lake Winnipeg.

**Eastern Phoebe.** *Sayornis phoebe*. I did not hear or see a phoebe until I was on the return leg of the trip at Thicket Portage on the Hudson's Bay Railway. Here a pair had a nest containing five downy young on the porch of a cabin which, incidentally, housed a cat. A pair also had a nest in Tommy Singleton's cache on Cross Portage. Preble recorded several nests along Hell Gate Gorge on the Hayes River, but it was this stretch of the river that my guide avoided by detouring through Max Lake.

**Alder Flycatcher.** *Empidonax traillii*. There were just two instances on the trip when I felt certain in my identification of the Alder Flycatcher. Its call, and the bird itself, was noted in an alder thicket in the marsh at the western end of Robinson Lake, and the bird was again met with on the Hayes River above Oxford Lake. Many miles of suitable habitat were passed and flycatchers were seen therein, but none voiced the *wee-be-o* call of the alder, and I did not attempt to identify them.

**Least Flycatcher.** *Empidonax minimus*. On the northward trip this bird was encountered by the third dam of the Echimamish, on the Logan-Max Lake portage, on the Hayes River below Windy Lake, and finally on the Hayes River between the mouths of the Fox and God's Rivers. On the return trip, one was heard at Thicket Portage and one at Cross Portage.

**Tree Swallow.** *Iridoprocne bicolor*. Tree swallows were seen at Berens River, on the trip from Lake Winnipeg to Norway House, Norway House itself, on the Nelson River below Sea River Falls, one on the Echimamish River, and a few swallows were noted over the marsh at the western end of Robinson Lake. This bird has apparently decreased in numbers since Preble's trip.

**Bank Swallow.** *Riparia riparia*. Many were flying about the Red River near the S. S. KEENORA'S dock at Selkirk. Preble noted several colonies of these swallows on his trip to York Factory.

**Barn Swallow.** *Hirundo rustica*. Several were seen in with the Bank Swallows flying about the S. S. KEENORA'S dock at Selkirk, and a few were seen near a barn on Matheson Island. Preble did not report this bird south of York Factory.

**Northern Cliff Swallow.** *Petrochelidon pyrrhonota*. The railway station at Gillam, on the Hudson's Bay line, supported a colony

of cliff swallows under its eaves, and a few more were seen at Pikwitonei, on the railroad south of Gillam.

**Canada Jay.** *Perisoreus canadensis*. Not many jays were seen on the trip. Several were seen on the Echimamish, one on Oxford Lake, and a few on the Hayes River above York Factory. On the return trip a few were noted on the Weir River and several on Cross Portage. The young birds were noted most often and readily responded to squeaking, coming very close. Tommy Singleton stated he saw little of them until the end of the summer.

**American Magpie.** *Pica pica*. No magpies were met with, but Tommy Singleton informed me that for the last two years they have come to the Cross Portage area during the winter, and have made a nuisance of themselves by robbing and springing traps.

**Raven.** *Corvus corax*. This species was seen regularly, but in small numbers, from the Nelson River below Little Playgreen Lake to Knee Lake, and again on the Weir River and at Cross Portage. Many times, however, I did not attempt to distinguish between crows and ravens.

**Crow.** *Corvus brachyrhynchos*. Crows were noted irregularly, in small numbers, from Berens River to the Bay, but none were seen or heard on the return trip.

**Black-capped Chickadee.** *Parus atricapillus*. I saw but one chickadee on the entire trip. The bird was noted June 14 on a portage on the Hayes River below Back Lake.

**Robin.** *Turdus migratorius*. A robin was seen at Berens River, and the species was seen or heard throughout the rest of the trip. Curiously, and directly opposed to Preble's observations, very few robins were seen in the vicinity of posts and cabins. The bird is extremely wary in the wilderness. It is often heard rather than seen. Along the Hayes River from Swampy Lake to the mouth of God's River the robin was more numerous than at any other time on the trip, and together with the Spotted Sandpiper comprised the bulk of the bird observations in this area. The above mentioned region was predominantly stunted spruce muskeg.

**Olive-backed Thrush.** *Hylocichla ustulata*. The song of this thrush was heard daily on the trip north to the Bay. None were heard at York Factory, but several were noted on the trip up to the railway. A few were last heard at Thicket Portage and in the Cross Portage area.

**Red-eyed Vireo.** *Vireo olivaceus*. The song of this species was heard at Selkirk, and it was noted very frequently from Lake Winnipeg to the Hayes River between the mouths of the Fox and God's Rivers. From this point the bird was not heard again until Thicket Portage, mile 185, on the Hudson's Bay Railway. It was also heard near Landing Lake and Cross Portage.

**Philadelphia Vireo.** *Vireo philadelphicus*. A pair of these vireos carrying nesting material was seen by the third dam of the Echimamish River on June 10.

**Tennessee Warbler.** *Vermivora peregrina*. This warbler was heard frequently from the Echimamish River to Oxford House, and again at York Factory. A few were also heard at Thicket Portage and Cross Portage. Preble mentions the species only at Oxford House and York Factory.

**Yellow Warbler.** *Dendroica petechia*. One was seen at Selkirk, one at Warren's Landing, and a pair at the Oxford House Hudson's Bay Post. It was later noted below the outlet of Swampy Lake, on the Hayes River above York Factory, and at York Factory itself. On the return trip it was noted on the Nelson River between the Bay and the mouth of the Weir River. It did not appear common at any point. Preble found it common at Norway House, Oxford House and York Factory.

**Myrtle Warbler.** *Dendroica coronata*. A few were noted in the vicinity of the Norway House Post.

**Oven-bird.** *Seiurus aurocapillus*. The call of the Oven-bird was heard at Norway House and at intervals until the section of the Hayes River connecting Back and Knee Lakes was reached. It was again noted at Thicket Portage on the Hudson's Bay Railway. Preble did not report this warbler.

**House Sparrow.** *Passer domesticus*. A few were seen at Selkirk, Matheson Island and at Berens River. Livestock is found at the latter two stops. Presumably, this species has appeared since Preble's observations.

**Red-wing.** *Agelaius phoeniceus*. The Red-wing was not numerous at any point along the route, and was not met with at all on the return trip. A few were seen from the Nelson River below Norway House to the passage connecting Oxford and Back Lakes in most suitable marshy locations.

**Baltimore Oriole.** *Icterus galbula*. A bird assigned to this species was seen at a range

of perhaps forty feet by myself and a companion in Selkirk. It flew from a low bush to a tree, so we had a good view of its back. The bird had the Baltimore's pattern and coloring with the exception of the tail. This was solid orange, like the back, and in the upper, center portion was a small, black, diamond-shaped mark with its long axis in the long axis of the bird's body. My companion and I agreed perfectly on this point. Preble noted a single Baltimore Oriole along the Red River between Winnipeg and Selkirk.

**Bronzed Grackle.** *Quiscalus quiscula*. The grackle was scarce throughout the trip. One was seen at Selkirk, one on Little Playgreen Lake, two on the upper Echimamish River, and two on the Hayes River below Swampy Lake. On the return trip several were noted at Pikwitonei on the railway. Preble made numerous observations of this bird on the first half of his trip to the Bay, so it has apparently decreased in numbers.

**Cowbird.** *Molothrus ater*. A single cowbird was noted at Berens River, and a few were seen at Warren's Landing. This species was not reported by Preble.

**Purple Finch.** *Carpodacus purpureus*. Several were seen and heard around Norway House. This bird was not reported by Preble beyond the northern end of Lake Winnipeg.

**Savannah Sparrow.** *Passerculus sandwichensis*. One was seen in the field behind the Norway House Post, and one was heard at Gillam on the railway. The species was common on Preble's trip.

**Chipping Sparrow.** *Spizella passerina*. One was seen at Berens River, one at Norway House, a few about the Oxford House Post, and several at Thicket Portage. I believe I

heard the chippy's song several times between these points, but not being too familiar with the similar song of the Slate-colored Junco (*Junco hyemalis*) I cannot be sure.

I did not see a junco on the trip, although Preble recorded them at Norway and Oxford Houses and on the lower Hayes River.

**White-crowned Sparrow.** *Zonotrichia leucophrys*. This sparrow was noted only along the Weir River, where its song was heard frequently. Preble observed it at York Factory.

**White-throated Sparrow.** *Zonotrichia albicollis*. Two white-throats were noted at Norway House, and it was heard almost daily to York Factory. A few were noted on the Weir River also.

**Song Sparrow.** *Melospiza melodia*. Song Sparrows were encountered along the entire route from Warren's Landing to York Factory. On the southward trip the bird was noted on the Nelson River above the Bay and a few were seen and heard on Cross Portage by Tommy Singleton's cabin. This sparrow has apparently increased in numbers since 1900 and has advanced farther north, since Preble did not meet with it beyond Knee Lake.

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## NOTES ON THE PALLID VOLE AND THE GRASSHOPPER MOUSE IN ALBERTA<sup>1</sup>

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THE LITERATURE dealing with Alberta mammals contains few records of the pallid vole and the grasshopper mouse. Pallid voles have been reported from Calgary (Bailey, V., N.A. Fauna 17, 1900), Lodge

Creek, 26 miles north of the International Boundary (Soper, J.D., Can. Field-Nat. 45, 1931) and Little Sandhill Creek, near Steveville (Anderson, R. M., Nat. Mus. of Can. Bull. 102, 1946). The grasshopper mouse has been recorded from Calgary and Medicine

<sup>1</sup> Received for publication October 25, 1952.

Table 1. Data for Pallid Voles Collected in Southern Alberta, 1951.

No.	Locality	Date	Sex	Length	Tail	Hind Foot	Ear	Weight (gms.)	Remarks
123	Compeer	June 23	F.	112	19	18	9	25.0	5 embryos (7 mm.)
132	Alsask	June 25	M.	101	16	18	9	18.6	Subadult
137	Youngstown	June 27	M.	111	16	17	9.5	34.0	Adult
138	Youngstown	June 27	F.	111	17	17	10	31.1	7 embryos (13 mm.)
157	Pollockville	July 10	F.	121	19	18	10	27.4	7 embryos (16 mm.)
174	Ralston	July 17	M.	101	18	17	9.5	14.5	Subadult
190	Cardston	July 21	F.	119	20	18	9	30.0	4 placental scars
239	Foremost	Aug. 12	M.	126	18	17.5	9.5	29.2	Adult
240	Foremost	Aug. 12	F.	125	18.5	18.5	10	29.0	4 embryos (12 mm.)
241	Foremost	Aug. 12	F.	134	18	17.5	9.5	31.5	5 placental scars
244	Milk River	Aug. 13	M.	113	16	18	10	27.0	Adult
258	Milk River	Aug. 16	M.	106	17	18	9	21.0	Subadult
287	Big Stone	Aug. 28	F.	108	17	16.5	10	—	6 embryos (10 mm.)
288	Big Stone	Aug. 28	M.	111	15	17	9.5	—	Adult

Hat (Hollister, N., U.S. Natl. Mus. Proc. 47, 1914) and from Little Sandhill Creek (Anderson, R.M., loc. cit.). Studies made in recent years have provided much additional information about these two species in Alberta.

Pallid Vole

During the summer of 1951 the writer and Mr. R. Lister obtained 14 specimens of *Lemmiscus curtatus pallidus* (Merriam) from 9 widely separated points in southern Alberta. These included Cardston, Milk River, Foremost, Ralston, Pollockville, Big Stone, Youngstown, Alsask and Compeer. An additional record was obtained near Wardlow where a partially consumed pallid vole was found to constitute the larder of a white-rumped shrike (*Lanius ludovicianus excubitorides*). On the basis of all available information it is believed that the range of this subspecies in Alberta includes practically the whole of the prairie region extending from latitude 49° north almost to 51° and from 110° to approximately 114° west longitude. Our record for Compeer extends the range of *Lemmiscus* to a point some 200 miles north of the International Boundary.

Table 1 presents the data for our specimens with all measurements in millimeters (ear length is measured from notch). Average measurements of adults from this area were 117-17.5-17.5 mm., and the average weight was 29.4 grams. Study skins are deposited in the collection of the Zoology Department, University of Alberta.

We collected pallid voles from a rather wide variety of habitats although generally these consisted of highland areas where the scanty vegetation included grasses, cactus, sagewort, winter fat, mallow and club-moss. In only one locality did we note evidence of extensive runways and that was in a patch of tansy mustard growing around a gravel pit near Cardston.

The food habits of this subspecies in North Dakota and Saskatchewan have been discussed by Bailey (N.A. Fauna 49, 1926) and Soper (loc. cit.). Dr. E. H. Moss of the Botany Department, University of Alberta, has kindly examined the stomach contents of 10 of our specimens. His report indicates that grass fragments usually formed the bulk of the recognizable material and in 7 cases there were considerable quantities of spores and sporophylls of the prairie club-moss, *Selaginella densa* Rydb.

Coupling our data with those of Soper (loc. cit. and Jour. Mammal. 27, 1946) it is evident that the breeding season of the pallid vole in the Alberta-Saskatchewan portion of its range extends over a period from at least June to September. Also, gravid females contained from 4 to 8 embryos, the average number being 6. Furthermore, Soper's collections indicate that at least three litters may be produced in a season.

Of the 14 specimens which we obtained, 2 from Foremost proved to have diseased livers. Further examination by Dr. R. B. Miller of this Department revealed that in



Table 2. Data for Grasshopper Mice From Southern Alberta.

No.	Locality	Date	Sex	Length	Tail	Hind Foot	Ear	Weight	Remarks
6	Pollockville	July 29/49	M.	—	—	—	—	—	—
7	San Francisco Lake	July 25/49	F.	130	34	20	—	—	4 embryos (12 mm.)
124	Compeer	June 23/51	F.	129	33	22	16	26.0	Adult
183	Taber	July 19/51	F.	138	32	22	16	35.1	6 placental scars
200	Vulcan	July 27/51	M.	125	31	20	15	26.4	Adult
235	Foremost	Aug. 11/51	F.	126	30	21	17	27.1	Adult
243	Foremost	Aug. 12/51	F.	137	31	21	17	31.3	3 placental scars
M-50-4	Compeer	July 20/50	F.	143	41	18	—	—	—
M-51-21	Hanna	July 3/51	M.	138	43	20	—	—	—

each instance there was a moderate infestation of nematodes, which as yet have not been identified. Collections of ectoparasites included the fleas *Monopsyllus wagneri systaltus* (Jord.) and *Megabothris clantoni* Hubb. as determined by Dr. G. P. Holland of the Department of Agriculture, Ottawa.

#### Grasshopper Mouse

Specimens of *Onychomys leucogaster missouriensis* (Audubon and Backmann) were collected at Foremost, Taber, Vulcan and Compeer in the summer of 1951. In addition, two former students, Mr. R. C. Anderson and Mr. W. S. Haynes have taken this subspecies at Pollockville and San Francisco Lake (south of Cassils) and at Compeer and Hanna respectively. It is apparent that the grasshopper mouse in Alberta has a range comparable to that of the pallid vole. Both are typical inhabitants of the Transition Life Zone of this region.

Data for all specimens mentioned above are given in Table 2. Average measurements were 133-34-20.5 mm. and the average weight was 29.2 grams. The specimen from Taber was in brown pelage while the rest were buffy grey in color. All individuals were taken on the open plains where cover

was almost negligible. Four of the animals were caught in traps set beside abandoned badger holes which possibly served as homes. Study skins prepared by Mr. Haynes are in the Museum of the Alberta Department of Public Health while the remainder are in the University of Alberta Zoology Department Collection.

The stomach contents of 4 specimens have been examined by Professor E. H. Strickland of the Entomology Department, University of Alberta. His study reveals that from 50 to 95% of the material was of animal origin mainly derived from insects. Beetles, especially ground beetles, were present in sufficient quantities to indicate that they constitute a favored diet. Grasshoppers, caterpillars, cutworms, dipterous larvae and adults were also represented. Two of the stomachs contained small amounts of hair. The vegetable material consisted mainly of leaf fragments.

Although our data are not sufficient to provide detailed information about reproductive activities, it is evident that 3 to 6 young may be born during late summer. Also, it seems reasonable to believe that at least one litter is produced earlier in the season.

BOTANICAL INVESTIGATIONS IN NORTHEAST ELLESMERE ISLAND, 1951<sup>1, 2, 3</sup>

P.F. BRUGGEMANN and J. A. CALDER

**Introduction**

THE SENIOR AUTHOR spent the season of 1951 at Alert, Ellesmere Island, N. W. T., as a member of one of the field parties sent out in the Northern Insect Survey, a project sponsored jointly by the Defence Research Board of Canada and Science Service of the Canada Department of Agriculture. Although the main object of the survey was the study and collecting of insects, with special emphasis on biting flies, botanical investigations were carried out when time permitted.

On account of the restricted accommodation available at the Alert weather station, the senior author was the sole member of the Ellesmere party. Mr. Stuart D. MacDonald, of the National Museum of Canada, however, was doing field work for his institution at the same time at Alert. He proved to be a very delightful companion and his valuable help was greatly appreciated.

Grateful acknowledgment is also made to the United States Weather Bureau and the Meteorological Service of the Canada Department of Transport, for providing accommodation and board at the joint United States-Canada weather station; to the officers and personnel of the station, for helping in great measure to make the season successful and enjoyable; and to the United States Military Air Transport Service and the Royal Canadian Air Force, for providing transportation.

The party arrived at Alert on April 16. During the first two months a preliminary survey of the district was carried out, mainly on skis. This extended for about 25 miles along the coast and from 5 to 10 miles inland. Lack of transportation made it difficult to carry the work farther afield. However, in early June, immediately before the beginning of the snow-melt, a sledge journey — without dogs — of 75 miles into the mountains of the northern part of the United States Range was undertaken. During this excursion the edge of the local ice cap in the vicinity of Mt. Grant was reached at a height of approximately 4300 feet, and a ridge of 4800 feet ascended. Near the middle of August a

forty mile pack trip to lower Wood Creek Valley ended in a snow-storm, which heralded the unexpectedly early and sudden return of winter. The resulting snow cover, which reached a depth of over one foot by the end of August, put a stop to field work several weeks before the party returned south on September 30.

**Previous Botanical Investigations in Northeast Ellesmere Island**

The first to explore the north coast of Ellesmere Island were members of the British Arctic Expedition under the command of Sir George Nares. One of his ships, H.M.S. *Alert*, wintered at Floeberg Beach, some ten miles east of the weather station, from early September, 1875, to the end of July, 1876. Capt. H. W. Feilden, the naturalist of the expedition, made a collection of plants in the district (Hart, 1880). He listed 37 species as occurring north of the 82nd parallel.

Peary visited the area several times when he attempted to reach the North Pole. His ship, the *Roosevelt*, wintered twice at Cape Sheridan, in 1905-06 and 1908-09. Among the meagre scientific results of his expeditions are three collections of plants, made by Dr. L. J. Wolf in 1906, Capt. R. A. Bartlett in 1908, and Dr. J. W. Goodsell in 1909. The species collected by Wolf and Goodsell are listed by Rydberg (Rydberg, 1911-12). Among these are five new records for the region. Nothing appears to have been published about the collections made by Bartlett except the citations by Polunin (Polunin, 1940); six species, including one doubtful one, were added to the records. Finally, Godfred Hansen, the leader of the Danish Third Thule Expedition, visited the north coast of Ellesmere in 1920. Nothing has been published about the work of this expedition, but, according to Polunin's citation (*l. c.*, p. 49), there is among Hansen's specimens at least one species that had not been recorded previously.

H. G. Simmons, who was a member of the Sverdrup Expedition of 1898-1902, contributed greatly to our knowledge of the flora of Ellesmere, through both his field work and a valuable paper (Simmons, 1906). Since he visited only the southern half of the island, he made no additions to the records for the north coast, which thus comprised a total

1) Contribution No. 3009, Division of Entomology, and No. 1218, Division of Botany Plant Pathology, Canada Department of Agriculture, Ottawa, Canada.

2) Project No. D49-68-01-07, Defence Research Board, Department of National Defence, Ottawa, Canada.

3) Received for publication January 29, 1953.

of approximately 50 known vascular species at the time the present investigations were undertaken.

### The Area

#### TOPOGRAPHY

The area surveyed extends along the coast of the extreme northeast corner of Ellesmere Island from 61°15'W to 63°40'W, that is, from Cape Rawson to a few miles west of Black Cliffs Bay. It lies between 82°25'N and 82°32'N and is therefore a part of one of the northernmost lands on the globe. Ellesmere Island itself extends, at Cape Columbia, a scant 40 miles closer to the Pole than Alert; only the north tip of Greenland exceeds Cape Columbia, by approximately an equal distance.

In striking contrast with the rugged east coast of Ellesmere, which rises abruptly from the sea to elevations of a thousand feet or more, the land from Cape Rawson to a point halfway between Dumbell and Colan Bay slopes rather gradually to the shore. About two miles inland the steep edge of a plateau runs roughly parallel to the coast, which is rather irregular in outline and is indented by numerous bays and inlets. The plateau, which lies at an elevation of 500 to 700 feet, is generally fairly level, but it is dissected by a great number of water courses. The larger of these have cut deep ravines and gorges that are often more than one hundred feet deep and have nearly vertical walls. To the south the plateau abuts against a chain of elongated, rounded hills extending to the west-southwest from Mt. Pullen, which, with an elevation of 1650 feet, is the highest point in the vicinity of the weather station.

In the west half of the area, at Colan and Black Cliffs Bay, hills, from 400 to 1000 feet high, rise steeply from the sea and form bold headlands and frowning cliffs. Viewed from Mt. Pullen, the country to the south and south-southwest rises very gradually in broad undulations to over 3000 feet. To the west-southwest, west, and northwest the sharp peaks and ridges of the northern end of the United States Range form the sky line. Pyramid-shaped Mt. Grant rises, according to the latest maps, to 6800 feet and is the highest, although not the most conspicuous, point visible. An ice cap, some 300 square miles in extent, sends glaciers through gaps between the peaks into the numerous valleys. The north-facing slopes of the mountains are covered by what appears to be perpetual snow, but the opposite sides become snow-

free for short periods during the summer. From Black Cliffs Bay the coast runs nearly due north for about 25 miles to the cliff-like Cape Joseph Henry, from where the land trends west-northwest to Cape Columbia. In the east, beyond the frozen Lincoln Sea and Robeson Channel, looms the coast of Greenland in the clear arctic air visible for more than 100 miles.

The Alert area contains four moderate-sized lakes and numerous ponds and pools. All of these, except Egerton Lake, became ice-free during the summer; the smaller ones cleared shortly after the snow had disappeared from the land, whereas the Dumbell Lakes, elevation about 25 feet, and Hawkins Lake, elevation about 75 feet, retained central sheets of ice until the second week of August, when winds of gale force broke them up and speeded their disappearance. Egerton Lake, at an elevation of 475 feet, had on July 26 only a narrow strip of water between the shore and the central mass of ice. This water was covered by about one inch of ice on August 11. The shallow ponds and pools froze over solidly during the night of August 27-28; the Dumbell Lakes stayed open until September 7 and a week later they were covered with about eight inches of ice.

#### GEOLOGY

Geologically the area is rather uniform. The country rock consists of highly calcareous, strongly metamorphosed sediments of presumably Palaeozoic age, the so-called Cape Rawson beds. The generally thin-bedded shales and slates have been severely and intricately folded. The strata often stand vertical and the strike of the folds is generally from west-southwest to east-northeast. No easily recognizable fossils were observed in these rocks.

The strata vary greatly in hardness and only the softer shales appear to disintegrate readily into stiff, fast-drying clays and silts. The beds of clay that accumulate on gentle slopes and more or less level areas lead to the development of polygon formations. Most of the finer silt particles are carried away by the large amount of run-off water resulting from the melting of the snow, which takes place with astonishing rapidity during the second half of June.

No unmistakable signs of glaciation were observed. The rocks are probably too soft and weather too easily to retain glacial striae for any length of time, and furthermore no trough-shaped valleys or cirques were ob-

Table 1  
SUMMARY OF WEATHER RECORDS NORTHEAST ELLESMERE ISLAND

NARES 1875-76				PEARY				ALERT 1950					ALERT 1951										
Month	Temperature			Total Ppt.	1905-06		1908-09		Temperature				Total Ppt.	% over- cast	Days with- out Frost	Snow on the Ground	Temperature			Total Ppt.	% over- cast	Days with- out Frost	Snow on the Ground
	Max.	Min.	Mean		Mean Temperature	Min.	Mean	Max.	Min.	Mean	Max.	Min.					Mean						
Jan.	9	-59	-33	.23	-30											-6.8	-53.8	-31.0	.04	32	0	9	
Feb.	2	-67	-38	.26	-33											12.7	-53.3	-24.4	.22	31	0	8-10	
Mar.	-8	-74	-40	.18	-32		-52									-3.9	-40.2	-22.7	.83	38	0	11	
April	15	-47	-18	.24	0		-37	-16								28.2	-40.4	-11.3	.53	36	0	10	
May	33	-15	11	.71	19		-15	18								46.5	-6.7	12.5	.36	70	0	10-12	
June	44	18	32	.66	(17 days)	32	15	32								57.1	11.9	33.4	1.16	70	10	10-0	
July	50	29	38	.46					64.5	30.0	43.3	.04	41	23		61.1	22.3	36.3	.72	70	10	0-1	
Aug.	44	25	32	.29	(27 days)	37			53.4	21.9	39.9	.16	62	8	1-0	48.1	9.9	31.1	2.13	80	7	1-13	
Sept.	37	0	16	.68	13				33.0	-5.5	13.7	.59	58	0	0-4	37.6	-4.4	17.9	1.17	76	0	6-12	
Oct.	21	-32	-5	.70	-8				17.1	-28.1	-7.6	.92	51	0	2-8	17.0	-32.0	-6.0	.70				
Nov.	23	-46	-17	.11	-17				31.0	-39.2	-17.1	.28	37	0	4-7	15.0	-36.0	-14.0	.20				
Dec.	35	-47	-22	.55	-22		-53		13.0	-45.8	-26.3	.21	31	0	7-9	0	-51.0	-29.0	.60				

served. The plateaus, the flat-topped or rounded mountains and ridges, and the conspicuously V-shaped valleys suggest that the present topography of the area as well as that of the country along Wood Creek has been shaped entirely by water erosion and frost action.

On the other hand there are many and obvious signs that the land has risen several hundred feet during post-glacial time. Many beds of marine silts and clays occur, containing masses of recent marine shells, that have been eroded into "bad lands" after emerging from the sea. Stepped gravel outwash fans and plains are well developed at the mouth of Parr Creek, on Hawkins Creek above the lake of the same name, and for some three miles along lower Wood Creek. Water-worn rocks and pebbles were found at an elevation of 450 feet between Colan Bay and Black Cliffs Bay. No arenaceous rocks occur and sand is entirely absent in the district. The shingle that covers present and ancient beaches consists almost entirely of flat fragments of slate varying in size from tiny flakes to pieces an inch or two in length.

#### CLIMATE

As is to be expected in this high latitude, the climate of northern Ellesmere Island is very severe. The scant records available, which are summarized in Table 1, indicate that the monthly mean temperatures for the coldest period, January to March, are about  $-30^{\circ}$  or lower, and that those for June, July, and August seldom exceed  $40^{\circ}$ . The growing season is short, and the ground is generally snow-free for only seven to nine weeks and during this time less than 30 days appear to be without frost, i.e., with a minimum of  $32^{\circ}$  or higher. The sun is continually above the horizon from March till September, but the daily temperature fluctuations are sometimes rather large. They vary from a few degrees on overcast days to  $30^{\circ}$  during clear periods, and occasionally reach  $40^{\circ}$ . Once or twice during the summer the temperature attains  $60^{\circ}$  or even  $65^{\circ}$ , but as a rule the daily maximum is well below the  $50^{\circ}$  mark.

The precipitation is very small and probably does not average more than five inches annually. Most of it falls as snow and, some as rather light rain, in June, July, and August. The summer months are not only the period of greatest precipitation and heaviest cloud cover, but also the windiest time of the year. The prevailing winds are westerly. During the summer they are generally only light to

fresh and are more frequent than during the winter, when they are also weaker. However, sudden violent gales, of usually short duration, may spring up at any time.

There is sufficient wind to cause drifting and the snow accumulates in large drifts, fills in valleys and depressions, and obliterates the finer topographical features, leaving only a thin cover on exposed and level tracts. It seldom becomes very tightly packed or heavily crusted. Once started, the melting of the snow progresses very rapidly and after a week or ten days only the largest drifts remain. Some of these rarely or ever disappear completely and their cores consist of firn or solid ice. Practically all the resulting melt-water runs off and the ground dries very quickly in spite of the humid atmosphere. The relative humidity is generally between 80 and 100 per cent and very seldom drops lower than 50 per cent for more than a few hours. These climatic factors produce desert conditions, which, combined with the scant and rather infertile soil, leave only a few small areas where a closed or luxuriant vegetation can develop.

#### VEGETATION

During the preliminary survey in April and May the country had all the aspects of a dreary waste of ice, snow, and rock, and only closer examination revealed a few withered blades and heads of grasses, and widely scattered, small groups of empty poppy seed pods barely overtopping the surface of the snow.

Here and there, bare windswept mounds serve snowy owls and falcons as perches. Foxes also frequent these places and lemmings burrow there under the rocks. The resulting liberal manuring favours a rather luxuriant growth of grasses and other flowering plants on these mounds. The flora of this type of community may conveniently be divided into two parts. The first is made up of the following species, which are almost invariably present in these habitats: *Poa abbreviata*, *Cerastium alpinum*, *Stellaria monantha*, *Papaver radiculatum*, and *Draba alpina*. The second part is extremely variable from place to place and may contain from one to several of the following species, which are mentioned in approximate order of frequency: *Oxyria digyna*, *Polygonum viviparum*, *Salix arctica*, *Saxifraga oppositifolia*, *Alopecurus alpinus*, *Puccinellia angustata* (near the coast), *Saxifraga cernua*, *Lychnis apetala*, and *Potentilla pulchella*. One of

these mounds was exceptional in that it was covered with a small, dense mat of the very rare *Lychnis triflora* to the exclusion of all other vegetation but a few tufts of grass.

In the vicinity of the weather station the general impression of barrenness persisted after the snow had disappeared. The tracts of very stony polygon soil support only a scant vegetation, which moreover tends to congregate in the cracks. These give protection and provide a better supply of the all-important moisture than the surface of the fast-drying, rounded hummocks, but they also hide the plants more or less effectively from casual view. In this type of habitat the following species occur in addition to those listed in the preceding paragraph: *Festuca brachyphylla*, *F. baffinensis*, *Luzula nivalis*, *Juncus biglumis*, various *Draba* spp., and *Saxifraga caespitosa*. Along the many temporary water courses the polygon formation is but poorly developed and few of the species mentioned above can tolerate the erosional disturbance that recurs every year during the early summer run-off. *Cerastium regelii* alone appears to maintain here a precarious foothold.

North-facing, gentle, and rather dry slopes along the coast support a fair growth of *Saxifraga oppositifolia*. Its drab, brownish mats cover about one-half of the surface of the ground and are interspersed with widely scattered tufts of grasses, *Papaver radicatum* and a few species of *Draba*. At the beginning and towards the end of the season these slopes look rather dreary and well deserve the name *Saxifraga oppositifolia* barrens; however, during the height of its flowering period this plant makes a most beautiful show and covers the hillsides with a mantle of purple.

Only a few, widely scattered areas provide all the conditions necessary for the establishment of a more or less closed, luxuriant vegetation. The main requirements appear to be: (1) a certain measure of fertility and depth of soil, which depends on the composition of the underlying rocks; (2) a sufficient amount of snow cover, which depends on the topography and the direction of the prevailing winds; (3) an ample and continuous supply of moisture. According to the source of the last the areas can conveniently be divided into three groups: (a) the margins of shallow ponds, e.g., Ravine Pond, a small pond one

mile southwest of Cape Belknap, and the ponds above Hawkins Lake; (b) the margins of sluggish streams, e.g., those of a tributary of Ravine Creek in the gap between Mt. Pullen and 'Dean'; (c) the flats or gentle slopes below persistent, slow-melting snow-drifts, e.g., the slopes at the bases of Mt. Pullen and 'Dean', the slope at the coast, two and one-half miles west of Cape Belknap, the slope at the mouth of Colan Bay opposite Cape Woollen, and the flat at the south shore of Hawkins Lake.

The composition of the plant assemblies of the different areas varies so much that it is difficult to group them according to communities or to associate them with different habitats. Detailed ecological studies were postponed until the end of the season because of other, more pressing work, and, unfortunately, the early heavy fall of snow made it impossible to carry them out. As a rough approximation it may be said that the patches of closed vegetation occupy only a small fraction of one per cent of the total land surface of the district under discussion.

In the following paragraphs some of these areas are described in detail.

Station 1 is a small, shallow pond on nearly level ground, about 95 feet above sea level, one mile southwest of Cape Belknap. Its shores and bottom are composed of very fine silt, so soft that snowshoes were used to collect the aquatic plants that are the most interesting feature of this locality. Around the outer margin of the pool, as well as those of several low islands, grows a compact belt of mosses, a few feet wide. Among the moss and in the open water occur rather conspicuous stands of *Ranunculus hyperboreus*, which reaches here its most northerly known point. Growing in the very edges of the moss mats and infrequently in open shallow water a second aquatic species of *Ranunculus* was found, quite by accident, as it was difficult to see, even when its presence was known. It has now been determined as *R. circinatus* var. *subrigidus* — a species hitherto unrecognized in the eastern Canadian Arctic. A third species that attains its highest latitude here is the fine and easily recognized grass *Pleuropogon sabinei*. It grows in conspicuous circles a few feet outside of the moss girdles of the islands and in short rows along the shore of the pond.

Station 4, two and one-half miles west of Cape Belknap, was the most accessible of the small, well-vegetated areas and therefore

the one most frequently visited. Here a cliff rises to 200 feet about 100 yards inland from the seashore. It is covered in its upper part by a large, persistent snowdrift, which assures abundant moisture for the gentle marshy slope at its foot. This supports a dense growth of mosses, *Eriophorum angustifolium* var. *triste*, *Salix arctica*, *Luzula nivalis*, *Juncus biglumis*, *Oxyria digyna*, and *Polygonum viviparum*. Among these the following grow more or less scattered: *Equisetum variegatum*, *Alopecurus alpinus*, *Phippsia algida*, *Poa abbreviata*, *Puccinellia angustata*, *Festuca brachyphylla*, *F. baffinensis*, *Carex misandra*, *Lychnis apetala*, *Cerastium alpinum*, *Stellaria monantha*, *Saxifraga cernua*, *S. nivalis* and its var. *tenuis*, *S. caespitosa*, and *S. flagellaris*. Near the lower edge of the snowdrift the vegetation begins to thin out and here are found *Ranunculus sabinei* and *Draba alpina*, and on the terrace-like, well-drained steps of the cliff, in addition to the species mentioned above, the following flourish: *Festuca brachyphylla* var. *vivipara*, *Papaver radicatum*, *Saxifraga oppositifolia*, *Potentilla pulchella*, and *Taraxacum phymatocarpum*.

The cliff faces due north and the shore is here much exposed to ice action. Gale-driven floes push up large mounds of shingle and muck along the beach. The disturbed soil of these is colonized by scattered tufts of *Puccinellia angustata*, *Festuca brachyphylla*, *Cerastium alpinum*, *C. regelii*, and *Stellaria monantha* and here are also found rather stunted rosettes of *Cochlearia officinalis* var. *groenlandica*.

Another well-vegetated, north-facing slope occurs between Jolliffe and Colan Bay. At its very narrow western end, opposite Cape Woollen, is one of the two known stations of *Equisetum arvense*. Towards Jolliffe Bay the slope widens and is not so marshy and here a fine stand of *Pedicularis hirsuta* was found. The slope east of Jolliffe Bay, which faces northwest, is cut into narrow ridges by a network of interconnected, more or less parallel runnels. In these grow elongated mats of *Dryas integrifolia*, which is otherwise very scattered in the vicinity of the weather station. The areas described here, as well as the *Saxifraga oppositifolia* "barrens" mentioned above, may account for Feilden's remark that north-facing slopes support the most luxuriant vegetation in this part of Ellesmere Island. This is true only for a narrow strip along the coast between

Colan Bay and Black Cape. Towards the west, where the topography is different, slopes with a southern aspect are usually better vegetated.

The mountainous country to the west contains many deep, sheltered valleys. Their floors, which are often very narrow, frequently provide conditions favourable for the development of rich plant growth. Here was also found evidence that elevation has little influence on the amount and composition of the vegetation. For instance, a gravel flat at the head of Wood Creek valley, at a height of 1900 feet, supported a plant community comparable to that of a similar habitat near sea level.

The following general remarks on the flora may be of interest: the species that here reach the northern limit of their distribution are usually widely scattered or found only at single stations, but sometimes in great numbers, e.g., *Equisetum arvense* (two stations), *Epilobium latifolium* (one station), whereas three or four, like *Equisetum variegatum*, *Arenaria rossii*, *Cochlearia officinalis* var. *groenlandica*, and *Saxifraga tricuspidata*, are of fairly general, if somewhat discontinuous, occurrence. Most of those species that reach still higher latitudes in northern Greenland are found practically everywhere; as exceptions to this may be cited: *Arctagrostis latifolia* (two or three stations), *Carex misandra* (very scattered), *Cardamine bellidifolia* (very rare), and *Dryas integrifolia* (in only a few patches).

The most characteristic features of the vegetation, apart from its not unexpected scantiness, appear to be the lack of zoning, which is so prominent in the more southern part of the Arctic, and the complete absence of the so-called late snowdrift communities.

#### Phenological Data

The dates of first flowering of a number of the species collected in the Alert area are given in Table 2. The conspicuous crowding about June 26 and on July 10 is explained by the fact that both dates were preceded by days of unusual warmth following a prolonged spell of low temperatures and overcast skies. For comparative purposes first flowering dates have been included in the table, for those species of which we have records at three other localities in the southern part of the eastern Canadian Arctic: (1) Chesterfield Inlet (63°21'N 90°42'W), Keewatin District (D.B.O. Savile and C.T. Watts, 1950); (2) Coral Harbour (64°09'N



Table 2  
EASTERN ARCTIC PHENOLOGY

Species	Alert, Ellesmere Island 82°30'N	Chesterfield Inlet 63°21'N	Coral Harbour, Southampton Island 64°09'N	Frobisher Bay, Baffin Island 63°45'N
<i>Saxifraga oppositifolia</i>	June 8	June 22 (—14)	—	—
<i>Salix arctica</i>	" 15	" 30 (—15)	—	—
<i>Cerastium alpinum</i>	" 21	July 4 (—13)	—	June 24 (—3)
<i>Draba alpina</i>	" 21	—	—	" 22 (—1)
<i>Papaver radicum</i>	" 24	" 5 (—11)	June 28 (—4)	" 24 (0)
<i>Oxyria digyna</i>	" 26	—	" 28 (—2)	" 24 (+2)
<i>Saxifraga nivalis</i>	" 29	" 10 (—11)	" 30 (—1)	" 25 (+4)
<i>Saxifraga caespitosa</i>	" 29	" 7 (—8)	July 2 (—3)	" 29 (0)
<i>Dryas integrifolia</i>	July 1	" 6 (—5)	—	" 22 (+9)
<i>Lychnis triflora</i>	" 10	—	—	July 3 (+7)
<i>Lychnis apetala</i>	" 10	—	—	June 22 (+8)
<i>Arenaria rubella</i>	" 10	" 10 (0)	" 2 (+8)	" 22 (+18)
<i>Stellaria monantha</i>	" 10	June 30 (+10)	—	—
<i>Pedicularis hirsuta</i>	" 16	July 8 (+8)	" 3 (+13)	" 24 (+22)
<i>Saxifraga tricuspidata</i>	" 24	" 4 (+20)	" 2 (+22)	" 25 (+29)
<i>Saxifraga hirculus</i>	August 5	" 14 (+22)	" 7 (+29)	—

83°05'W), Southampton Island, Keewatin District (W. J. Cody, 1948); (3) Frobisher Bay (63°45'N 68°34'W), Baffin Island (H. A. Senn and J. A. Calder, 1948).

Nearly all the dates recorded in the table are based on field observations; however, it has been necessary in a few cases to estimate the first flowering dates on the basis of the earliest made collections. When the Alert figures are used as a basis the spread in the first flowering dates for each species, in comparison with those from the other three localities, may be expressed as a positive or negative figure (in brackets) depending on whether they flowered at an earlier or later date. One of the striking features is the early flowering dates of *Saxifraga oppositifolia*, *Salix arctica*, and *Cerastium alpinum* at Alert as compared with those at Chesterfield Inlet, some 19° farther south. This is in part accounted for by the severe weather conditions at Chesterfield in June, 1950, the average maximum and minimum monthly temperatures being 37.7° and 29.9° respectively (mean 33.8°), and the absolute maximum reaching only 43°. The absolute maximum at Alert during the same period was 57.1° although the average mean temperature for the two localities was almost

the same (Table 1). The generally higher maximum daily temperatures and total daylight conditions with a subsequent rapid melting of the relatively light snow cover are important factors governing first anthesis. In comparable seasons and with similar exposures the gap in flowering dates would no doubt be substantially reduced. In the table there are no first flowering records from Coral Harbour or Frobisher Bay for the two earliest blooming species; however, the dates and figures suggest that anthesis of these takes place in the far north earlier than, or at least as early as, in localities farther south. As the growing season progresses the more southern localities with their higher daily temperatures close the gap in first flowering dates and by late June or early July surpass the more northerly localities, substantially widening the gap by the time the late flowering species come into bloom. A number of factors, the most important of which are the climatic conditions, exposure, topography, and habitat, have a decided bearing on the dates of anthesis. For example, the vegetation at Coral Harbour, situated on the south coast of Southampton Island with its relatively low relief and full exposure to cold sea winds, averaged about 6 days behind the Frobisher

Bay station, which had a more favourable climate due to its inland location and more varied topography.

### The Flora

In the following list 56 species are recorded from the vicinity of Alert. The majority of these have been previously reported from the area; however, the following 15 species represent additions to the local records: *Equisetum arvense*, *E. variegatum*, *Deschampsia brevifolia*, *Trisetum spicatum* var. *maidenii*, *Phippsia algida*, *Pleuropogon sabinei*, *Puccinellia phryganodes*, *P. paupercula*, *Eriophorum scheuchzeri*, *Arenaria rossii*, *Ranunculus circinatus* var. *subrigidus*, *R. hyperboreus*, *Draba cinerea*, *Saxifraga hirculus*, and *Erigeron eriocephalus*.

The following species collected by either Feilden or Bartlett were not noted during the survey:

*CYSTOPTERIS FRAGILIS* (L.) Bernh. — Grant Land, 82° 30'N, Bartlett, 1908.

*POA GLAUCA* M. Vahl — Grant Land, 82°30'N Bartlett, 1908.

*PUCCINELLIA VAHLIANA* (Liebm.) Scribner & Merrill — Grant Land, 82°27'N, Feilden, 1876.

*CAREX NARDINA* E. Fries — Floeberg Beach, Feilden, 1876.

*DRABA NIVALIS* Lil. — Dumbell Bay, Feilden, 1876.

*ERYSIMUM PALLASII* (Pursh) Fern. — Recorded by Polunin (*l.c.*, p. 248); however, not reported by Hart from the Alert region.

*POTENTILLA HYPARCTICA* Malte — Floeberg Beach, Feilden, 1875.

*CASSIOPE TETRAGONA* (L.) D. Don — Grant Land, 82°30'N, Bartlett, 1908.

During the final stages of the preparation of this paper a list of plants collected by Mr. S. D. MacDonald at Alert during the summer of 1951 was received. This collection has been determined by Mr. A. E. Porsild and is in the National Museum of Canada. It contains one new record for the Alert area:

*CAREX STANS* Drej.

There is therefore a total of 65 species of vascular plants represented in the eastern Canadian Arctic north of latitude 82°N. The families represented and the respective

number of species in each are as follows:

<i>EQUISETACEAE</i> .....	2
<i>POLYPODIACEAE</i> .....	1
<i>GRAMINEAE</i> .....	16
<i>CYPERACEAE</i> .....	5
<i>JUNCACEAE</i> .....	2
<i>SALICACEAE</i> .....	1
<i>POLYGONACEAE</i> .....	2
<i>CARYOPHYLLACEAE</i> .....	7
<i>RANUNCULACEAE</i> .....	4
<i>PAPAVERACEAE</i> .....	1
<i>CRUCIFERAE</i> .....	9
<i>SAXIFRAGACEAE</i> .....	7
<i>ROSACEAE</i> .....	3
<i>ONAGRACEAE</i> .....	1
<i>ERICACEAE</i> .....	1
<i>SCROPHULARIACEAE</i> .....	1
<i>COMPOSITAE</i> .....	2

Table 3, column 1, lists those species that represent new northern range extensions for the Arctic and Ellesmere Island; column 2 the collection number(s) or sight record of the senior author; columns 3 and 5 the previous northernmost records for the Arctic and Ellesmere Island respectively; and column 4 the northernmost latitude at which the species was noted in the Alert area. Many of the records represent a northward extension of only a few miles. At such a latitude the distance, however, is of a significance.

The writers would like to express their appreciation to the following individuals for determinations: Drs. B. Boivin (*Lychnis*) and W. G. Dore (*Gramineae* in part) of the Division of Botany and Plant Pathology, Canada Department of Agriculture; Mr. J. R. Swallen (*Puccinellia* in part) of the Smithsonian Institution, Washington, D.C.

### EQUISETACEAE

#### *EQUISETUM ARVENSE* L.

On small tussocks among mosses, grasses, and willows, mouth of Colan Bay opposite Cape Woollen, 82°31'N 62°45'W, No. 1864; marshy, mossy flat along small stream, 500 foot saddle between Egerton Lake and Hilgard Bay, 82°28'N 63°20'W, No. 221.

Apparently rare in the Alert area although possibly overlooked. Noted only on two occasions: No. 186, July 4, was restricted to a small area on a steep, wet, north-facing slope at the foot of a snow-covered cliff, 15 to 30 feet above sea level — the fertile shoots

4) All the collections cited by number were made by the senior author, and are in the herbarium of the Division of Botany and Plant Pathology.

Table 3

## ARCTIC AND ELLESMERE ISLAND NORTHERN RANGE EXTENSIONS

Species	Collection No(s).	Previous Northernmost Record * N. Lat.	Alert Area Records N. Lat.	Previous Ellesmere Northernmost Record N. Lat.
<i>Equisetum arvense</i>	186	82°29' Gr.	82°31'	81°44'
<i>Equisetum variegatum</i>	178	82°03' Gr.	82°31'	81°44'
<i>Deschampsia brevifolia</i>	244, 245	82°28' Gr.	82°30'	81°44'
<i>Trisetum spicatum</i>	265	—	82°30'	81°44'
<i>Phippsia algida</i>	240	—	82°32'	81°44'
<i>Pleuropogon sabinei</i>	225, 286	82°29' Gr.	82°31'	76°52'
<i>Poa hartzii</i>	277	?82°30' Ell.	82°32'	?82°30'
<i>Puccinellia phryganodes</i>	253, 284	82°03' Gr.	82°29'	78°49' - 79°00'
<i>Puccinellia paupercula</i>	279	74°35' D.I.	82°32'	—
<i>Puccinellia angustata</i>	246	—	82°32'	82°27'
<i>Festuca baffinensis</i>	236	82°27' Ell.	82°32'	82°27'
<i>Eriophorum scheuchzeri</i>	261	82°28' Gr.	82°30'	81°44'
<i>Eriophorum angustifolium</i>	185	—	82°32'	82°27'
<i>Carex misandra</i>	234	—	82°32'	82°27'
<i>Juncus biglumis</i>	193	—	82°32'	82°27'
<i>Oxyria digyna</i>	212	—	82°32'	82°27'
<i>Polygonum viviparum</i>	207	—	82°32'	82°27'
<i>Lychnis apetala</i>	194	—	82°32'	?82°30'
<i>Cerastium regelii</i>	251	—	82°30'	82°27'
<i>Stellaria monantha</i>	237	—	82°32'	82°27'
<i>Arenaria rossii</i>	252, 262	82°29' Gr.	82°30'	81°44'
<i>Ranunculus circinatus</i>	224, 285	?	82°31'	?
<i>Ranunculus hyperboreus</i>	198, 226	82°29' Gr.	82°31'	78°48' - 78°57'
<i>Cochlearia officinalis</i>	179, 184, 242	82°30' Ell.	82°32'	82°30'
<i>Draba fladnizensis</i>	201, 203	—	82°28'	?
<i>Draba cinerea</i>	181, 205	—	82°32'	?81°44'
<i>Braya purpurascens</i>	200, 222, 223, 231	82°27' Ell.	82°28'	82°27'
<i>Saxifraga caespitosa</i>	223	—	82°32'	82°30'
<i>Saxifraga tricuspidata</i>	sight record	82°27' Ell.	82°31'	82°27'
<i>Saxifraga flagellaris</i>	199	—	82°30'	82°28'
<i>Saxifraga hirculus</i>	271	79°57' Sp.	82°31'	?76°52'
<i>Pedicularis hirsuta</i>	208	—	82°31'	82°30'
<i>Erigeron erioccephalus</i>	280	—	82°31'	81°44'
<i>Taraxacum</i>	206	82°28' Gr.	82°32'	82°28'
<i>phymatocarpum</i>		& Ell.		

\* The latitudes and localities listed are those recorded by Polunin (1950); Gr. = Greenland, Ell. = Ellesmere Island, D.I. = Devon Island, Sp. = Spitzbergen.

were fully developed and the strobili were producing large quantities of spores; No. 221, July 6, consisted of a sterile colony among mosses and *Eriophorum angustifolium*.

A slight northward range extension for Ellesmere Island and the Arctic.

*EQUISETUM VARIEGATUM* Schleich.

Marshy slope of stiff clay below persistent

snowdrift near seashore, among mosses and *Eriophorum angustifolium*, west shore of Joliffe Bay, 82°31'N 62°40'W, No. 178.

Rather generally distributed throughout the area in suitable habitats to beyond 500 feet in elevation.

A northern range extension of 47' for Ellesmere Island and 28' for the Arctic.

## GRAMINEAE

*ALOPECURUS ALPINUS* Sm.

Wet, mossy clay and gravel slope below old snowdrift, mouth of Parr Inlet, 82°30'N 62°18'W, No. 243.

Probably the most common grass in the district, growing mostly in pure stands in marshy areas, and in and around shallow ponds and pools.

*ARCTAGROSTIS LATIFOLIA* (R. Br.)

Griseb. var. *LATIFOLIA*.

Marshy, gentle north-facing slope near shore, growing in widely scattered, small stands among mosses and *Eriophorum angustifolium*, Parr Inlet, 82°29'N 62°21'W, No. 283.

Rare, found only in small stands in widely scattered stations.

*DESCHAMPSIA BREVIFOLIA* R. Br.

Damp clay and gravel slope above shoreline and below old snowdrift, mouth of Parr Inlet, 82°30'N 62°18'W, Nos. 244, 245.

Frequent, forming densely caespitose, compact, roundish cushions up to 10 cm. in diameter on damp, marshy slopes and flats near the shore and inland.

A slight northern range extension for Ellesmere Island and the Arctic.

*TRISTETUM SPICATUM* (L.) Richt. var.

*MAIDENII* (Gand.) Fern.

Small, damp solifluction slope, valley of Wood Creek, 82°30'N 63°26'W, No. 265.

Apparently very rare as it was noted only once during the survey. Represented by two small clumps in the habitat cited above, where it was growing with *Salix arctica*, *Saxifraga nivalis*, *Oxyria digyna*, *Polygonum viviparum*, mosses, and other grasses. It is only in the most favourable seasons that *T. spicatum* is likely to set seed at this latitude. The collection, made on August 13, had young flowering spikes which undoubtedly did not reach maturity in 1951, and from an examination of the previous year's spikes this was also the case in 1950.

A slight range extension northward for Ellesmere Island.

*PHIPPSIA ALGIDA* (Sol.) R. Br.

Gravel and shingle mounds along sea-shore, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 240; damp silt at high-water mark, head of Parr Inlet, 82°29'N 62°21'W, Nos. 254, 255; open, damp, silt and clay flats and slopes along shore, Parr Inlet, 82°30'N 62°18'W, No. 275.

Common along the coast and in marshes

inland. The culms, up to 8 cm. in length, are usually prostrate and the plants form fan-shaped or circular clumps up to 10 cm. in diameter. It flowered freely during 1951 and set viable seed.

A slight range extension northward for Ellesmere Island.

*PLEUROPOGON SABINEI* R. Br.

Shallow drying-up pond, 1 mile southwest of Cape Belknap, 82°31'N 62°17'W, Nos. 225, 286.

A rare species in the area, found only in the locality cited, where it was growing (in narrow bands) on the silt bottom of a shallow pond, adjacent to the mats of mosses which lined the margin. It occurred also around the numerous small islets.

A slight northern extension for the Arctic and one of 5°39' for Ellesmere Island.

*POA ABBREVIATA* R. Br.

Dry, open clay and gravel slope, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 239; damp to dry, clay and gravel slope, and open silt and clay flats, Parr Inlet, 82°30'N 62°18'W, Nos. 247, 276; small, damp, solifluction slope, valley of small tributary of Wood Creek, 82°30'N 63°26'W, No. 268.

The most common species of *Poa* in the area and, next to *Alopecurus alpinus*, the most abundant grass species. Widely distributed both inland and along the coast. Previously collected by Feilden at Floeberg Beach and Dumbell Bay.

*POA HARTZII* Gand. var. *VIVIPARA* Polunin

Open, dry, rocky clay and gravel plains and slopes, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 277.

*P. hartzii* is apparently a rare species in the Alert area although possibly overlooked. It is represented by the single viviparous collection cited and, according to Polunin (*l.c.*, p. 71), was also collected by Bartlett (as *P. cenisia* — Grant Land) in the area.

*POA ARCTICA* R. Br.

Manured silt-gravel mound on spur of valley slope, valley of tributary of Wood Creek, 82°30'N 63°40'W, No. 260.

Only noted at the above station, where a few plants were found in an area of about one square metre.

*PUCCINELLIA PHRYGANODES* (Trin.)

Scribner & Merrill

Silty shore below and at high-water mark, forming loose mats up to one metre in length, head of Parr Inlet, 82°29'N 62°21'W, Nos. 253, 284.

Rare in the Alert area, where it was noted (but not plentiful) only on three occasions; head of Parr Inlet, at the outlet of Lower Dumbell Lake in Colan Bay, and at the head of Hilgard Bay. It grows on the silty seashore, at and below highwater mark but only in situations sheltered from severe ice action and abrasion such as the heads of deep, narrow inlets. It forms loose mats up to about one metre in length, frequently becomes covered with silt during the spring run-off, and then sends up a mass of erect, sterile shoots 4 to 6 cm. high. It apparently does not flower at this latitude since all colonies noted were sterile with no evidence of flowering in the previous season. Its restricted distribution is due no doubt to the fact that it reproduces solely by vegetative offshoots.

A range extension northwards of approximately 3°29' for Ellesmere Island and 26' for the Arctic.

*PUCCINELLIA PAUPERCULA* (Holm)  
Fern. & Weath.

Silt and shingle mounds at seashore, forming small tufts 3 to 6 cm. in diameter, 2 miles west of Cape Belnap, 82°32'N 62°28'W, No. 279 (det. J.R. Swallen).

Occasional along the seashores in habitats similar to those of *P. angustata*.

A considerable range extension northwards for the Arctic.

*PUCCINELLIA ANGUSTATA* (R. Br.) Nash

Gravel and shingle mounds along seashore, forming flattened tufts, 2 miles west of Cape Belnap, 82°32'N 62°28'W, No. 241 (det. J.R. Swallen); damp clay and gravel slope, forming roundish clumps up to 30 cm. in diameter, Parr Inlet, 82°30'N 62°18'W, No. 246.

Rather common along the seashores on gravel or shingle mounds pushed up by ice-floes, on damp silt and clay flats, and on well-manured areas (fox mounds) near the shoreline.

*FESTUCA BAFFINENSIS* Polunin

Rocky gravel and clay slope, 2 miles west of Cape Belnap, 82°32'N 62°28'W, No. 236; small, damp solifluction slope, valley of small tributary of Wood Creek, 82°30'N 63°26'W, No. 267.

Common on damp clay and gravel slopes. A slight northern range extension for Ellesmere Island and the Arctic.

This species was described by Polunin (*l.c.*, p. 91) on the basis of material from

Pond Inlet and Cape Dorset in northern and southern Baffin Island respectively, and from Ellesmere Island. There is now at hand a good series of this species from the following widely scattered localities in the Canadian Arctic: Frobisher Bay, Baffin Island; Coral Harbour, Southampton Island; Repulse Bay, Melville Peninsula; Resolute Bay, Cornwallis Island; King William Island; Spence Bay, Boothia Peninsula; Cambridge Bay, Victoria Island. Although the material as a whole agrees well with Polunin's original description, there is considerable variation in anther length, and in the colour and shape of the panicle. The anthers (dry), which are usually about 0.4 or 0.5 mm. in length, are occasionally longer (up to 0.7 mm.); the panicle, although in most cases darker coloured than in *F. brachyphylla*, at times lacks the dark purple pigmentation, and its shape is occasionally "lance-ovate." It seems advisable, however, to maintain this as a species rather than a varietal segregate of *F. brachyphylla*, on the basis of the distinguishing characters pointed out by Polunin, its geographic distribution, and cytological studies that have been made by Dr. W.M. Bowden which will be published at a later date.

*FESTUCA BRACHYPHYLLA* Schultes

Small, damp solifluction slope, valley of small tributary of Wood Creek, 82°30'N 63°26'W, No. 266; rocky clay and gravel slope, 2 miles west of Cape Belnap, 82°32'N 62°28'W, No. 235.

*F. brachyphylla* is common in habitats similar to that of the preceding species and widely distributed throughout the area. The viviparous form is represented only by the second collection cited, which was made on a well-drained (but not dry) clay terrace below a persistent snowbank.

## CYPERACEAE

*ERIOPHORUM SCHEUCHZERI* Hoppe

Closed marsh near head of valley, a scattered stand among *E. angustifolium* var. *triste*, grasses, and mosses, valley of tributary of Wood Creek, 82°30'N 63°40'W, No. 261; closed marsh, forming a dense stand among grasses, mosses, and *E. angustifolium* var. *triste*, delta of tributary of lower Wood Creek, 82°31'N 63°23'W, No. 269.

A relatively rare species widely scattered in the area. In addition to the two collections cited three other stations were discovered, two in the Hilgard Bay region, and a

third in a marsh about one-half mile southwest of Hawkins Lake.

A northern range extension of some 39' for Ellesmere Island and 3' for the Arctic.

*ERIOPHORUM ANGUSTIFOLIUM* Honck.  
var. *TRISTE* Fries

Wet, mossy clay and rock slope below large snowdrift, 2½ miles west of Cape Belknap, 82°32'N 62°30'W, No. 185; marshy, north-facing, gentle slope near shore, head of Parr Inlet, 82°29'N 62°21'W, No. 281.

Common everywhere in marshy and damp situations. Collection No. 281 consists of plants ranging from 9-18 cm. in height, the smaller ones having 2-3 heads, and the larger, more robust individuals having up to 13 heads per inflorescence. It was first observed in flower on June 26.

A slight northern range extension for Ellesmere Island.

*CAREX MISANDRA* R. Br.

Damp, mossy clay and gravel slope, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 234.

Common, but found only scattered in marshy or at least damp situations. A slight northern range extension for Ellesmere Island.

### JUNCACEAE

*LUZULA NIVALIS* (Laest.) Beurl.

Damp, mossy clay slope, scattered clumps among mosses, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 197; wet, mossy slope, forming tufts 10 to 15 cm. in diameter, foot of 'Dean', 82°26'N 62°10'W, No. 217; marshy, north-facing, gentle slope near shore, forming loose tufts up to 20 cm. across, Parr Inlet, 82°29'N 62°21'W, No. 282.

Common in moist and marshy situations throughout the area, and occasionally dominant in some of the associations.

Flowering specimens first noted on July 10.

*JUNCUS BIGLUMIS* L.

Damp, mossy clay slope, growing scattered, singly, or a few together, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 193.

Common, growing everywhere in marshy and damp areas. Usually found as single individuals or in small colonies, but occasionally forming small, pure stands especially in polygon soil cracks. First seen in flower on July 10.

A slight northern range extension for Ellesmere Island.

### SALICACEAE

*SALIX ARCTICA* Pall.

Damp gravel and clay slope, mouth of Parr Inlet, 82°30'N 62°18'W, No. 248.

Common, growing everywhere in a wide variety of habitats, setting and ripening fruit abundantly in favourable seasons even at this latitude. It is heavily browsed by musk-oxen, which were plentiful in the area and, along with the grasses, is one of their principal sources of food. In addition to the collection cited, rust-infected plants were obtained at the station two miles west of Cape Belknap and on a clay slope northeast of Parr Inlet.

### POLYGONACEAE

*OXYRIA DIGYNA* (L.) Hill

In cracks in polygon soil on open, exposed, clay flats, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 212.

Common, growing everywhere in a great variety of habitats. A slight northern range extension for Ellesmere Island.

*POLYGONUM VIVIPARUM* L.

Damp clay and rock slope, growing gregariously in small stands, 2½ miles west of Cape Belknap, 82°32'N 62°30'W, No. 207; marshy, rock and scree slope, Shirley Creek, Hilgard Bay, 82°27'N 63°12'W, No. 258.

Common, growing everywhere in a wide variety of habitats and rarely attaining more than 8-10 cm. in height. The spikes are usually few-flowered (2-5) at the apex with the lower axils bearing bulbils, although entirely bulbiferous spikes are rather common. Plants with the greater portion of the inflorescence floriferous are relatively rare (No. 258).

*P. viviparum* is extremely variable in the far north as to the colour of the flowers, which ranges from white to pink, and in the size and shape of the basal leaves, which even on individual plants may vary from oblong-ovate to lance-linear. From field observations at various localities in the Arctic and sub-Arctic, forma *alpinum* (Wahl.) Polunin with "... foliis inferioribus ellipticis, floribus roseis..." seems hardly worthy of recognition.

### CARYOPHYLLACEAE

*LYCHNIS TRIFLORA* R. Br. (= *L. furcata* sensu Polunin)

Cracks in polygon soil on dry, clay and gravel slope, growing somewhat gregariously, apparently very local and scarce, between Parr Inlet and Ravine Bay, 82°30'N 62°14'W, No. 230; marshy, open gravel flat, May Creek

delta, Lower Dumbell Lake, 82°29'N 62°35'W, No. 257; small, damp solifluction slope, valley of tributary of Wood Creek, 82°30'N 63°26'W, No. 264.

Widely scattered and noted only on four occasions, growing gregariously in cracks of polygon, soil, and exceptionally on "fox mounds" or solifluction slopes. The latter two collections cited consisted of but single specimens each, whereas that from the Parr Inlet-Ravine Bay region was from a dense colony about one square metre in extent. Flowering specimens were first noted on July 10.

*LYCHNIS APETALA* L. var. *ARCTICA*

(Fries) Cody (= *L. apetala* var. *nutans* Boivin; *L. apetala* sensu Polunin)

Damp, mossy clay slope, scattered among mosses and on bare soil, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 194.

A common species in the area, growing gregariously on marshy slopes, in polygon cracks, and on gravel flats. First noted in flower on July 10.

*CERASTIUM ALPINUM* L.

Well-manured, low rocky knoll, Alert, 82°30'N, 62°25'W, No. 176; clay and rock slopes, 2 miles west of Cape Belknap, 82°32'N 62°28'W, Nos. 180, 238; shingle and clay ridges pushed up by icefloes, 2½ miles west of Cape Belknap, 82°32'N 62°30'W, No. 189.

Common, growing everywhere in a great variety of habitats. It is as widely scattered as *Saxifraga oppositifolia* but not quite as abundant.

*CERASTIUM REGELII* Ostenfeld

Damp to dry, open clay and gravel slopes, near mouth of Parr Inlet, 82°30'N 62°18'W, No. 251.

Common, growing on damp gravel and clay slopes, gravel flats, along melt-water streams and on mounds of disturbed soil along the seashore, forming compact rounded cushions or loose mats. It apparently does not flower at this latitude.

*STELLARIA MONANTHA* Hulten var. *MONANTHA* (*S. longipes* Goldie, in part)

Gravel slope about 20 feet above high-water mark, Hilgard Bay, 82°27'N 63°12'W, No. 209; gravel and shingle mounds along the seashore, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 237; damp, mossy floodplain, delta of tributary of lower Wood Creek, 82°31'N 63°23'W, No. 270.

Common, forming dense colonies in areas of shingle and gravel along the seashore, and inland on moist floodplains and damp

gravel slopes.

*ARENARIA ROSSII* R. Br.

Marshy clay and gravel flat, south of Hawkins Lake, 82°28'N 62°53'W. No. 202; damp, open clay and gravel slope, forming hemispherical cushions up to 10 cm. in diameter, Parr Inlet, 82°30'N 62°18'W, No. 252; damp, mossy, gravelly valley floor, south of lower Wood Creek, 82°30'N 63°35'W, No. 262.

Frequent, growing in compact hemispherical cushions on marshy flats and damp slopes. It flowers late and sparingly, but must develop mature seed in less severe seasons since a few mature capsules from the previous year were present on No. 262. The collections represent a slight range extension northwards for the Arctic.

A var. *daethiana* Polunin has been described as "having petals acute and distinctly exceeding the sepals" (Polunin *l.c.*, page 201). Flowering material of *A. rossii* has been examined from Southampton Island, King William Island, Melville Peninsula, Boothia Peninsula, Cornwallis Island, and Ellesmere Island, and in these cases the petals are distinctly longer than sepals. The excess of the petal length over that of the sepals is extremely variable, ranging from about 0.2- (0.6)-1.0 mm.; the shape of the petals also varies greatly. Thus it seems that the common phase in the area is var. *daethiana*. However, the specific description by Robert Brown reads in part "petala... calyce paululum longiora". Var. *daethiana* is therefore the same as the typical plant and the name should be relegated to synonymy.

*ARENARIA RUBELLA* (Wahl.) Sm. f. *EPI-LIS* (Fern.) Polunin

Silt, gravel, and shingle mound at seashore, forming tufts 2-5 cm. in diameter, Floeberg Beach, 82°27'N 61°25'W, No. 227.

Occasional, forming compact cushions on mounds of disturbed soil at the seashore, and on damp, gravel flats and slopes inland. It both flowers and sets seed freely.

Although reported by Hart (*l.c.*, p. 182) from north of 82°27' he lists no localities, nor does Polunin or Simmons.

**RANUNCULACEAE**

*RANUNCULUS CIRCINATUS* Sibth. var. *SUBRIGIDUS* (W. Drew) Benson

In open, shallow water and among mosses in pond, 1 mile SW of Cape Belknap, 82°31'N 62°17'W, Nos. 224, 285.

This species was found only in the locality cited, where it grew in association with *R. hyperboreus* Rottb. f. *hyperboreus*. A few



colonies were noted in open, shallow water (5 cm. in depth), forming small mats on the fine silt bottom; however, it occurred mostly along the margins of large mats of mosses. The plants are unusually small, being about 2-3 cm. in length and proportionately reduced in size in all their parts. Collection No. 285 (August 24) is sterile and No. 244 (July 28) is in the same condition except for one plant, which bears a single flower which has the petals and sepals of almost equal length, a little less than 2 mm. long. There is some evidence that this flower is not fully developed.

The collections were originally determined as such by Dr. B. Boivin and at a later date were sent to Dr. Lyman Benson, who has made the following comments "... I think that the best disposal of these two collections, Nos. 224, 285, for the time being, is as *R. circinatus* var. *subrigidus*... I am not certain whether this single flower is a mature one, or that the petals are fully expanded ... in many species of *Ranunculus* there is a considerable elongation of the petals after the flower opens, and the petals elongate rapidly from a length of a little longer than the sepals to one perhaps twice as long. If these petals have attained their full length, their proportion to the sepals certainly is in marked contrast to that of var. *subrigidus*... There is a possibility of course, that this may be a new species or variety. However, the fact that the evidence is from a single flower which may not be mature, together with the lack of fruit makes it impossible to tell at this time..."

It is possible that some of the Arctic and sub-Arctic material that has been recorded by various authors under *R. aquatilis* L. var. *eradicatus* Laestad. (= *R. trichophyllus* Chaix var. *eradicatus* (Laestad.) Drew should be referred either to this species or to *R. codyanus* Boivin. In any event, the collections cited represent a major northern range extension for the subgenus *Batrachium* (DC.) Gray.

**RANUNCULUS HYPERBOREUS** Rottb. forma **HYPERBOREUS**

Wet, mossy margin of drying-up pond, growing both in open water and among mosses, forming loose mats from 25 square dm. up to 100 square dm. in extent, no indication of flowering observed, 1 mile SW of Cape Belknap, 82°31'N 62°17'W, Nos. 198 (July 13), 226 (July 28); shallow pond on silt and gravel flat, growing in open water

and among mosses, between Parr Inlet and Ravine Bay, 82°30'N 62°14'W, No. 229.

Frequent in open water or among mosses in shallow ponds and sluggish streams. The two collections from near Cape Belknap are sterile and show no indication of flowering, whereas that from the Parr Inlet-Ravine Bay region has fully developed flowers. Flowering colonies were also observed at the outlet of Egerton Lake. Although it probably produces mature fruit in favourable seasons, its principal means of propagation in the far north seems to be by vegetative offshoots. It was noted in flower only on a few occasions.

The above collections represent a considerable northern range extension for *Ellesmere* Island and a northernmost record for the species.

**RANUNCULUS SULPHUREUS** Solander

Wet, marshy ground and hillsides below lasting snowdrifts, plants growing singly or in small clumps, between Mt. Pullen and 'Dean', 82°26'N 62°11'W, No. 191; damp, mossy ravine, growing gregariously in compact clumps of about a dozen plants, Cape Sheridan, 82°28'N 61°28'W, No. 204; marshy clay and silt slope above shore, associated with *R. sabinei*, Hilgard Bay, 82°27'N 63°14'W, No. 210; damp to wet mossy slopes, marshy ground along streamlets, plants growing gregariously, often in tight clumps, foot of 'Dean', 82°26'N 62°10'W, No. 214; wet, mossy, silt bottom of ravine, plants growing singly or in small tight clumps, Cape Sheridan, 82°28'N 61°28'W, No. 228.

A common species in the Alert area, growing almost everywhere in marshy situations both inland and along the coast. It is occasionally associated with *R. sabinei*, in the coastal areas. Although Hart and Simmons record the closely related *R. nivalis* from the area (Floeborg Beach), Polunin is undoubtedly correct in referring Feilden's collection to this species.

**RANUNCULUS SABINEI** R. Br. (= *R. auricomus* sensu Hart, l.c., p. 144)

Marshy slope at foot of snow-covered cliff, mouth of Colan Bay, opposite Cape Woollen, 82°31'N 62°45'W, No. 188; damp to wet clay slopes below long-lasting snowdrifts near coast, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 195.

From field observations in the Alert area there is little doubt that *R. sabinei* is a good species, which, although closely related to *R. nivalis* and *R. sulphureus*, is markedly distinct. It may readily be distinguished in the flowering stage from the more southern

*R. pygmaeus* by its much larger flowers with reddish-coloured sepals and thick, fleshy leaves; in the fruiting stage, by the stiffly erect pedicels. The distinguishing characters for *R. sabinei* and the three species mentioned have been clearly set out by Simmons (*l.c.*, pp. 111-113, pl. 3, figs. 2-8), and our specimens are an almost perfect match for the material he has illustrated.

In addition to the gross morphological characters by which *R. sabinei* may be determined, it is, at least in northernmost Ellesmere Island, a species of marshy flats and slopes, restricted to a narrow belt along the coast. It was not noted on any of the surveys made inland. Its flowering period, although showing some overlap, is considerably earlier than that of *R. sulphureus*, the only other species of the section *Epirotes* found in the area. *R. sabinei* which is barely 2 cm. high, when the flowers first open, was first noted in full bloom on June 29 and subsequently collected in flower on July 4 and July 10. *R. sulphureus*, first appeared in flower on July 5, and further flowering collections were made on July 8, 19, 20, 24, and August 1. These observations confirm those made by Hart (*l.c.*, page 144) in the Discovery Bay region a short distance to the south. *R. sabinei* was collected by Feilden at Dumbell Bay and Floeberg Beach (*vide* Simmons).

### PAPAVERACEAE

#### PAPAVER RADICATUM Rottb.

Damp to dry, open clay and gravel slope, growing singly or more often gregariously especially about lemming holes and bird rocks, Parr Inlet, 82°30'N 62°18'W, Nos. 249, 250; ridges of shingle and clay pushed up by ice-floes, mouth of Colan Bay opposite Cape Woollen, 82°31'N 62°45'W, No. 187.

Common in the Alert area, growing almost everywhere. The last two collections cited are referable to the predominantly far northern var. *albiflorum* Porsild, which is occasionally found in pure stands but more often intermixed with the typical phase. It is estimated that approximately 30% of the individuals in the area were of the white-flowered phase. Flowers were noted first on June 24 and by mid-July it was at its height of bloom. It ripens seed in favourable seasons but did not do so in 1951 as the plants were buried by a heavy snowfall on August 14.

### CRUCIFERAE

#### COCHLERIA OFFICINALIS L. var. GROENLANDICA (L.) Gelert

Shingle, gravel and clay mounds and ridges along seashore, 2 miles west of Cape Belknap, 82°32'N 62°28'W, Nos. 179, 242; shingle and clay ridges pushed up by ice along shore, 2½ miles west of Cape Belknap, 82°32'N 62°30'W, No. 184; low, marshy ground along creeks and ponds, 5-6 miles from seashore, between Mt. Pullen and 'Dean', 82°26'N 62°11'W, No. 192.

Frequent, growing in damp situations all along the coast and in marshes inland, where it is more luxuriant than near the sea. It forms small rosettes up to 15 cm. in diameter with the outer flowering axes radially procumbent and the centre one(s) erect, 1-3 cm. in height. In favourable seasons it ripens seed but little was produced in 1951; it is either an annual or a biennial in the far north, as pointed out by Simmons. The specimens cited are perhaps best referred to var. *groenlandica* (L.) Gelert, which has ovoid siliques with short stigmas.

A slight northern range extension for both Ellesmere Island and the Arctic.

#### CARDAMINE BELLIDIFOLIA L.

Small, damp solifluction slope, valley of tributary of Wood Creek, 82°30'N 63°26'W, No. 263.

Apparently very rare in the area as only a single specimen was found during the survey. It grew on a small solifluction slope in an otherwise barren valley. Possibly overlooked but certainly not common.

Hart did not record this species from the Alert area, nor was it recorded by Simmons from this far north. Polunin, however, has cited two collections of Feilden, one from Dumbell Harbour and the other from Floeberg Beach.

#### DRABA ALPINA L.

Dry, exposed clay slope, near mouth of Parr Inlet, 82°30'N 62°20'W, No. 211.

Common everywhere in a wide range of moist and dry habitats. It flowers and fruits profusely in favourable years but only one plant, in a very sheltered habitat, was observed to have set ripe fruit in 1951.

#### DRABA SUBCAPITATA Simmons

Clay and rock slopes, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 182.

This species was described by Simmons on the basis of Ellesmere Island material

(*l.c.*, p. 236) and our specimens are a good match for the flowering and fruiting specimens illustrated in plate I, figures 3-7. No ecological notes are available for this species or the two that follow because of some confusion with various other species of *Draba*.

**DRABA FLADNIZENSIS** Wulfen

Open, dry to damp clay and scree slopes, ridge, south of Hawkins Lake, 82°28'N 62°56'W, No. 201; top of wet mossy slope, 600 foot hill SW of Hawkins Lake, 82°28'N 62°55'W, No. 203.

*D. fladnizensis* has not been recorded by Polunin (*l.c.*, p. 238) north of Discovery Harbour (81°43'N 64°45'W) in Ellesmere Island. Simmons, however, states "Occurrence ... North Coast ... this species is not mentioned by Hart yet I have seen specimens among collections of the Nares expedition, referred to *D. rupestris*."

**DRABA CINEREA** Adams

Slope of stiff clay, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 181; open, exposed, clay and gravel plain near seashore, growing widely scattered and forming dense, round cushions, 2½ miles west of Cape Belknap, 82°32'N 62°30'W, No. 205.

A slight northern range extension for Ellesmere Island.

**BRAYA PURPURASCENS** (R. Br.) Bunge

Open, dry to damp clay and scree slopes and plains, ridge north of Hawkins Lake, 82°28'N 62°55'W, No. 200; marshy to dry clay and gravel slope, south shore of Hawkins Lake, 82°28'N 62°53'W, Nos. 222, 223; marshy flat in ravine, Cape Sheridan, 82°28'N 61°28'W, No. 231.

Frequent in marshy, wet habitats to an elevation of approximately 500 feet above sea level.

A slight northern range extension for Ellesmere Island and the Arctic.

**SAXIFRAGACEAE**

**SAXIFRAGA CERNUA** L.

Exposed, open clay and gravel slopes, growing gregariously in small clumps, about 1 mile east of Ravine Pond, 82°27'N 61°48'W, No. 219.

Common, growing everywhere in almost every type of habitat. There is rarely more than a single flower terminating the spike, and frequently none (f. *bulbillosa* Engler & Irmscher).

**SAXIFRAGA CAESPITOSA** L.

Moist clay and gravel slope, cracks in

polygon soil, 2 miles west of Cape Belknap, 82°32'N 62°28'W, No. 233.

Common, growing everywhere on open clay and gravel plains and slopes and in cracks of polygon soil. There are two phases in the area which grow intermingled in approximately equal proportions; one has greenish-yellow flowers, and the other white flowers which in comparison are larger and more open. All the material belongs to Engler and Irmscher's ssp. *eucaespitosa*.

**SAXIFRAGA NIVALIS** L.

Damp to wet mossy slopes, marshy ground along streamlets, between Mt. Pullen and 'Dean', 82°26'N 62°11'W, Nos. 215, 216.

Frequent throughout the area, growing singly or in small stands among mosses in marshy areas. Var. *tenuis* Wahl. (No. 216), which is smaller and fewer-flowered, is usually associated with the typical phase.

**SAXIFRAGA TRICUSPIDATA** Rottb.

Dry, exposed clay and gravel slopes, densely caespitose, forming mats up to 50 cm. in length, 2 miles east of Ravine Pond, 82°27'N 61°48'W, No. 218.

Rare in the vicinity of Alert, where it was collected only at the above station. It was noted as common on gravel plains and slopes in and near Wood Creek valley, where it was almost past flower on August 11.

A slight northern range extension for Ellesmere Island and the Arctic.

**SAXIFRAGA FLAGELLARIS** Willd.

Wet, marshy ground, between Mt. Pullen and 'Dean', 82°26'N 62°11'W, No. 190; damp, open clay and silt slope a few feet above sea level, mouth of Parr Inlet, 82°30'N 62°18'W, No. 199.

Frequent, growing singly or in small colonies among open or closed vegetation in marshy or damp situations, never on barren or exposed ground. It was first seen in flower on July 5.

A slight northern range extension for Ellesmere Island.

**SAXIFRAGA HIRCULUS** L.

Closed marsh, growing in small, dense clumps or singly among grasses and mosses, delta of tributary of lower Wood Creek, 82°31'N 63°23'W, No. 271.

A rare species in the area, growing in association with *Eriophorum scheuchzeri*, *E. angustifolium* var. *triste*, and mosses at the station cited, where it was represented by a flourishing colony spread over some 200 square metres on swampy ground. In addition

to the above collection it was noted in full flower on August 11 on marshy ground along the west shore of Egerton Lake.

An Arctic range extension of  $2^{\circ}34'$ , and a northward extension for Ellesmere Island of  $5^{\circ}39'$ .

#### SAXIFRAGA OPPOSITIFOLIA L.

Open, exposed, gravel and clay plains and slopes, generally closely pulvinate, near mouth of Parr Inlet,  $82^{\circ}31'N$   $62^{\circ}25'W$ , No. 213.

The most common and numerous species in the district, growing in almost every situation from the driest to the wettest, even in closed marshes. It flowers profusely, setting and ripening seed abundantly at least in normal seasons.

#### ROSACEAE

##### POTENTILLA? PULCHELLA R. Br.

Dry, exposed clay and gravel slopes, forming cushions up to 15 cm. in diameter, 2 miles east of Ravine Pond,  $82^{\circ}27'N$   $61^{\circ}48'W$ , No. 220; open, gravel outwash plain, delta of tributary of lower Wood Creek,  $82^{\circ}31'N$   $63^{\circ}24'W$ , No. 272.

Common throughout the area in the more exposed and drier habitats.

##### DRYAS INTEGRIFOLIA M. Vahl

Dry, open clay and gravel slope, occasional and rather local, 2 miles west of Cape Belknap,  $82^{\circ}32'N$   $62^{\circ}28'W$ , No. 232.

Only occasional in the immediate vicinity of Alert, where it grows in a few places in cracks in polygon soil and on scree slopes. It is more abundant in Wood Creek Valley, where it occurs on gravel plains and slopes. Its flowers are perhaps the least frost-resistant of all those occurring in the district.

#### ONAGRACEAE

##### EPILOBIUM LATIFOLIUM L.

Marshy, rock and scree slope, mouth of Shirley Creek, Hilgard Bay,  $82^{\circ}27'N$ ,  $63^{\circ}12'W$ , No. 259.

A very rare species in the area, found only at the single station cited, where it covered a damp silt and gravel terrace of about 1,000 square metres with a dense luxuriant growth about 15 cm. high. All the plants noted were sterile except a few growing in the shelter of a boulder; these had well-developed flower buds which, however, failed to open as the season progressed. There was no concrete evidence that flower buds had opened in the previous season. The above collection was made at the same latitude as that of Feilden (Floeberg Beach), which is a northernmost record for the species.

#### SCROPHULARIACEAE

##### PEDICULARIS HIRSUTA L.

Marshy silt and gravel flat near seashore, mouth of Colan Bay opposite Cape Woollen,  $82^{\circ}32'N$   $62^{\circ}45'W$ , No. 208.

Frequent in the western half of the area, where it grows gregariously on damp or marshy gravel plains and slopes. It was first noted in flower on July 16, and in favourable seasons apparently sets and ripens seeds abundantly.

#### COMPOSITAE

##### ERIGERON ERIOCEPHALUS J. Vahl

South-facing, damp slope, found among stand of *Eriophorum angustifolium* on a snow-free spot, Wood Creek Valley,  $82^{\circ}31'N$   $63^{\circ}44'W$ , No. 280.

A rare species in the Alert area. The collection cited comprises a few plants of the previous season with fruiting heads collected on June 8 on a small, marshy, snow-free slope on the north side of Wood Creek. This spot was inaccessible in August and in spite of a prolonged search on the south side of the Creek no further colonies were located.

A slight northern range extension for Ellesmere Island.

##### TARAXACUM PHYMATOCARPUM J. Vahl

Dry to damp clay and rock slope, growing gregariously in small colonies,  $2\frac{1}{2}$  miles west of Cape Belknap,  $82^{\circ}32'N$   $62^{\circ}30'W$ , No. 206; damp, rocky, clay and scree slope, Wood Creek,  $82^{\circ}30'N$   $63^{\circ}27'W$ , No. 274.

Frequent in small colonies on dry to damp clay and gravel slopes, the decumbent scapes 1-5 cm. long. It normally sets seed abundantly and ripens it, except in unfavourable seasons as the one in 1951. It was first observed in flower on July 10.

A slight northern range extension for Ellesmere Island and the Arctic.

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## NOTES ON THE LIFE HISTORY OF THE MUSKRAT IN SOUTHERN ONTARIO<sup>1, 2</sup>

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### METHOD

MOST of these data were gathered during three months of study in a 20-acre section of a 175-acre marsh at Oshawa, Ontario. During winter and early spring the marsh was observed periodically, but during the trapping season (early April) and from April 29 to May 15, it was visited daily. The marsh was examined once or twice each following month until October.

Houses were conspicuously numbered in the marsh and plotted on a map. In searching for litters the upper half of the house on the side under the peak was carefully lifted. Nests were usually on that side of the house. After recording data the house was allowed to resettle — the whole procedure causing very little disturbance to the cabin.

Much of the data on adults is from trappers' catches, some animals of which had been tagged during this study.

### OBSERVATIONS

#### A. Breeding and Litter Size.

1. *Breeding Season.* The breeding season of the muskrat lasts all year in southern United States, for example in Texas, and California (6, 9). Further north, in Maryland, and Wisconsin, earliest breeding is in March (7, 2).

From the Lake St. Clair area of southern Ontario, Hewitt (4) reports rutting about the second week in March with the first litter arriving in April.

To further check the season, particularly along the Lake Ontario shore, 41 uteri, taken

during the run of 1947 (April), were examined but no embryos were visible macroscopically. This indicates breeding had not generally occurred earlier. Females mature at this time, however; three pairs of ovaries selected during the run of the following year (March) contained ripe follicles. Each ovary of two females in their first year contained from four to seven large ripe follicles, and an older female with a greatly enriched uterine blood supply had four large and three smaller follicles. That first breeding of the year is occurring at this time is substantiated by trappers who first find females with embryos two or three weeks after the run.

Thus the breeding season is longer where climate is consistently warm, but in southern Ontario it did not generally occur before the spring thaw of March 1948, and April 1947.

2. *Gestation.* According to the U.S. Fish and Wildlife Service (11) carefully controlled matings of pen-raised animals show gestation to take 29 to 31 days. Similarly in southern Ontario, captive animals have been observed to take 28 days (10) and a period of about 30 days is suggested by the birth of a large per cent of litters in a marsh on May 7, 8, and 9, one month after the run of April 8, 1947.

3. *Litter distribution.* In the spring of 1947 at Oshawa, the first litter found was born April 29, the highest per cent arrived between May 7-9, and others appeared until July. The actual numbers found in 20 acres were as follows:

April	15 - 30 :	1
May	1 - 15 :	8
	16 - 31 :	3
June	1 - 15 :	3
	16 - 30 :	1

<sup>1</sup> From an M.A. thesis submitted to the Department of Zoology, University of Toronto; financed in part by the Research Council of Ontario and the Royal Ontario Museum of Zoology.

<sup>2</sup> Received for publication October 27, 1952.

July 1 - 15: 2  
16 - 31: 0

After July, no houses were examined for litters but other observations indicate that further litters were unlikely. Forty-one animals live-trapped in September and October did not appear in breeding condition, nor were any of them young enough to have been born as late as August.

Apparently then, a large number of muskrats breed during the run, thus having first litters together early in spring. Second or late first litters are more haphazard in time of arrival, seconds being born to only a fraction of animals having an early first litter.

4. *Litter Size.* Although factors such as population density and food must have their effect, litters seem to be smaller where the breeding season is longer. Embryo counts gave averages of 3.85 and 4.1 for litters in the warmer states of Louisiana and Texas respectively (6). Further north in Iowa they vary from one to 11 but average 6.3 (3). In Ontario Hewitt found embryos increased from 6.6 to 7.3 to 8.0 from March 21 to April 1 (4).

Actual litter counts were made by the author from April to July. Of 19 litters found, 15 were believed complete. Their size ranged from two to 13, averaging 6.1. A litter of 13 is unusually large. Although female pelts show only 10 mammae, this litter of 13 was being successfully raised. The young were estimated to be six days old and all appeared healthy.

Actual counts of litter size were:

2 3 4 4 5 6 6 6 6 7 7 7 10 13

5. *Number of Litters per Year.* According to trappers' opinions the number of litters produced annually varies from one to four. Most who said "three" or "four" based their opinion on hearsay or sports magazines. However some thought "two" because they had seen young in both early and late summer, and had caught what they considered a young and also a very young grade of animal in spring. Although these two observations are suggestive, they are not entirely valid evidence that two litters are born in one season.

Young seen late in the year are not necessarily from a second litter. Forty-two litters, raised in captivity from muskrats paired in spring before April 5, arrived at various times from May until as late as August, but all were first litters (10).

Similarly, small animals caught in spring could well be from such single litters of the year born as late as August, or they might

be members of an earlier litter whose growth through some cause had been stunted.

Nevertheless a number of factors suggest that more than one litter is sometimes born.

a) Several trappers and naturalists have seen two litters of young in the same locality — one in May, the other in July or August, where confusion with other muskrat families was unlikely.

b) A female taken in September had 14 placental scars. These were probably from at least two litters born that summer.

c) Population increases 11 times that of the previous year have been estimated by house counts in Manitoba (1). This could hardly be accounted for on the basis of one litter.

e) In captivity in southern Ontario one litter is the rule from one-year-old females according to Toole (12) who raised approximately 40 litters a year, and Irwin who had as many as 500 penned animals. In Washington, however, breeders say three litters may be produced between May and September although two is more usual. (8).

An idea widespread among trappers is that animals from an early litter have young of their own late the same summer, but neither Johnson (5) nor the writer found any evidence to substantiate this belief. None of three first year females taken in September and October contained either embryos or placental scars, and as has been mentioned, no females tagged during October appeared to be breeding.

## B. Care of Young.

Presumably in preparation for their young, many muskrats were repairing their houses two weeks after the run in 1947, and the following week 21 repaired houses and 20 in disrepair were examined and tabulated.

Old unused nests were wet and cold, but in occupied houses nests were rebuilt much higher in the house and were lined with dry leaves of cat-tail, sedges, bur-reed, or other plants. Special preparation is made immediately preceding the birth of a litter. If clean dry leaves have been shredded to form a soft ball of nesting material, young may be expected there within two or three days.

Sudden floods or rising water may swamp nests or float houses away. In such conditions adults may build the house larger and move the nest higher, put the young on top of the house, or move them to some floating body.

Moving the nest higher is very common,

for example on May 14, after water had risen 13 in. in three days, a pair of muskrats were building their house larger. One was piling vegetation on the outside, and the other, judging from the bulging movements of the top of the house, was inside pushing and excavating a nest higher in the cabin. When opened, the nest was found to be eight inches higher than its position four days earlier, and still contained two young in a dry nest of shredded leaves.

Animals may move to the roof, or leave, if the house is floated from its foundation. Eighty feet from one such house, in a new open nest on a floating cat-tail clump, four young were found, with an adult nearby.

In spite of such care given young in the nest, they are frequently found emaciated, floating in cold water of the plunge hole, scratched, cut, or with such mutilations as foot amputation and injured eyes.

Two examples of the hardiness of young muskrats follow.

One, about four days old, and still naked, was picked out of the cold water of a plunge hole where it had been for some time. It was quite stiff and cold to the touch and was taken for dead. It was left in a canoe for about 20 min. but showed no sign of life so was put in a six-ounce jar and the cap screwed on. When, after six hours, the jar was opened the muskrat was squirming and squeaking but still cold. It took milk readily, and the next day was returned in lively condition to the nest.

While a litter of young was being tagged, one animal 17 days old, weighing only  $3\frac{1}{2}$  oz. swam away and escaped. About one hour later, it came swimming back. It had probably been in water the whole hour, since only sparse grasses grew for some distance from the cabin, and there was no other place to climb. After the hour's swim, it was floating lower in the water, was wet, shaky, appeared tired, and did not try to evade capture a second time.

### C. Period of House Construction.

The following observations, contrary to widespread opinion that a pair of muskrats inhabit a house for a summer or even several years, suggest they maintain the winter house in spring, only if an early litter arrives. Otherwise the house is abandoned, and adults live in open nests. During the summer they build and maintain a house only while actually raising a litter. In fall, however, practically all marsh animals construct houses in prepara-

tion for winter.

House repairing was first noted from two to three weeks after the spring run or mating period. By the time litters were arriving, 26 houses showing fresh work were found in 25 acres under study, and nine of these contained litters.

When revisited in June, (one month after the birth of young) only five of the 26 cabins were inhabited; the tops of two were being used as open nests; and ten were in complete disrepair (nine not recorded). Evidently houses were being abandoned as young became independent, and animals were living in open nests — five of which were noted. In spite of such abandonment, four new houses had been built, possibly by animals anticipating litters, since one of the new houses did contain young muskrats.

The following month (July) similar changes had occurred. Of the nine houses inhabited in June, only one was being used, and four were in disrepair (four not recorded). As in the previous month new houses had been constructed — probably for new litters, since one of these already contained a litter. Muskrats without young were living in open nests, for many were seen in these structures.

By the end of July vegetation was so high and dense that it was difficult to make way through the marsh, and houses could be seen only when very close. In one brief tour through the marsh, two litters were found and both were in houses constructed since July 2. A number of open nests were seen, frequently containing adult muskrats.

In fall activity increases. In 12 acres which contained only two houses in July, 12 were under construction on Oct. 23, and six additional ones were started in the two succeeding days.

In six acres of a different marsh similar fall changes occurred. In July three houses — two used as feeding stations and one as an open nest — and two additional feeding stations were the only signs seen. In August one new feeding station appeared, and by September one house was started. By the middle of October four houses and numerous feeding stations appeared, and by the end of that month 14 houses and many feeding stations were evident.

It seems reasonable to conclude that in the marshes studied houses were built for raising young — a new house and nest for each litter; whereas 'rats without dependent



families abandoned houses and used open nests.

During summer, in the marshes studied, there were few houses, few animals were trapped, comparatively few seen, and their feeding signs and droppings were unusually scarce. Just why muskrats disappeared in summer is not clear. A common belief is that they "lay up" in banks. Additional factors possibly involved are: a) many live in inconspicuous nests, and b) feed only in sheltered locations; c) such signs are hidden by dense summer growth.

### SUMMARY

Although muskrats may breed all year round in southern United States, they do not generally do so before ice goes out in spring in southern Ontario. After a gestation period of 28-30 days, a litter averaging six, somewhat larger than litters of southern U.S., is born. A family inhabiting a cabin does so until the young become independent at 4-6 weeks, when it is usually abandoned.

These animals, and other adults without young, may live in open nests, building a cabin only when a litter is expected. In fall probably all marsh muskrats construct winter houses.

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## NOTES ON THE BIRDS OF KLUANE GAME SANCTUARY, YUKON TERRITORY<sup>1</sup>

A. W. F. BANFIELD

*Canadian Wildlife Service, Banff, Alberta.*

**W**ILDLIFE investigations were undertaken in the Kluane Game Sanctuary of southwestern Yukon Territory during June, 1951. Although big game and fur-bearers were the major species studied, incidental notes were kept upon the birds observed.

The bird life of the region has been described by Godfrey (1951) and Rand (1946). However, several additional bird observations made during the present investigation merit recording.

The Kluane Game Sanctuary, comprising an area of approximately 10,000 square miles, is situated in extreme southwestern Yukon Territory. Alaska and the 60th parallel of latitude form its western and southern boundaries. About two-thirds of the area is composed of the glacier-clad St. Elias Mountain and much of the remainder is alpine tundra. The boreal forest extends up the valleys to an elevation of about 3,800 feet.

The Sanctuary was reached on June 4 and the interior was explored by pack-train from June 6 to 19. On the 20th and 21st

<sup>1</sup> Received for publication November 29, 1952.

the White River was visited and the Haines road was traversed on the 22nd and 23rd. The ground investigation was terminated at the Haines Junction on the 24th. On June 28 an aerial reconnaissance flight was made over the Sanctuary.

#### Annotated List

**Swan.** *Olor* sp.

A pair of swans, the species of which could not be determined, was seen on Tepee Lake on June 13.

**Black Brant.** *Branta nigricans* (Lawrence)

Three black brant were observed on Teslin Lake, Y. T., on June 3, on the trip to the Sanctuary.

**Golden Eagle.** *Aquila chrysaetos* (Linnaeus)

Golden eagles were commonly distributed about the higher elevations of the Sanctuary. A nest was found in Sheep Creek canyon on June 21. Both adults were present. Two observations upon eagle-white sheep (*Ovis dalli*) relationships made during the investigation, led me to conclude that these raptors take a number of young lambs.

I watched an eagle harry a ewe on a mountain slope above Tepee Lake on June 11. The bird plummeted down with closed wings, from a great height. It checked its fall with open wings about 15 feet above the sheep, and soared up in a steep climb. This procedure was repeated several times. The sheep was disturbed and fled across the slope. The eagle then landed on a rock where the first swoop was made, but I could see no prey.

An eagle was watched circling above a ewe and lamb on the same mountain on June 15. The ewe made a number of short runs towards a cliff. Each time, the lamb followed closely and pressed against the ewe's flank. The eagle made one shallow swoop. The sheep soon reached the cliff and stood huddled on a narrow ledge. They remained on the alert for some time after the eagle departed.

**Golden Plover.** *Pluvialis dominica* (Muller)

These plover were observed commonly on the alpine tundra of the Sanctuary at Burwash Creek summit; above Tepee Lake; near Klutlan Glacier; Edith Creek summit; and Haines Road summit. From their actions they were thought to be on their nesting grounds.

**Wilson's Snipe.** *Capella gallinago* (Ord)

A snipe was flushed from a nest, containing four eggs, in a sedge meadow at Tepee

Lake, on June 13.

**Hudsonian Curlew.** *Numenius phaeopus hudsonicus* (Latham)

Five curlews were seen on the alpine tundra at Burwash Creek summit on June 7. From their bold actions and cries it was thought that they were on their nesting grounds.

**Upland Plover.** *Bartramia longicauda* (Bechstein)

Upland plovers are commonly distributed in timberline bogs. On June 11, a plover was flushed from a nest, containing four eggs, situated at the base of a dwarf birch in a spruce-sphagnum bog at Wolverine Creek pass.

**Long-tailed Jaeger.** *Stercorarius longicaudus* (Vieillot)

One was observed quartering low over the tundra at Edith Creek summit on June 17.

**Grey-cheeked Thrush.** *Hylocichla minima* (Lafresnaye)

One was observed near Burwash Landing on June 5. These thrushes were common in the shrubs along the banks of streams at the Haines Road summit on June 23.

**American Pipit.** *Anthus spinoletta* (Linnaeus)

Pipits were commonly distributed on the alpine tundra. A pair were noted carrying food, on a rock talus, at Edith Creek summit, June 17.

**Common Redpoll.** *Acanthis flammea* (Linnaeus)

These are commonly distributed in the boreal forest near treeline. A nest containing four eggs was found in a small spruce at Tepee Lake, on June 11.

**Timberline Sparrow.** *Spizella breweri taverneri* (Swarth and Brooks)

Several singing males were observed on Sheep Mountain, on June 21.

**Golden-crowned Sparrow.** *Zonotrichia coronata* (Pallas)

A singing male was observed at Burwash Creek summit, on June 7.

**Fox sparrow.** *Passerella iliaca* (Merrem)

A singing male was seen at Wade Creek summit, on June 9.

**Lapland Longspur.** *Calcarius lapponicus* (Linnaeus)

These longspurs were noted only at Burwash Creek summit, June 7, and Edith Creek summit, June 17.

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## ADDITIONS TO THE LIST OF BANFF NATIONAL PARK, BIRDS<sup>1</sup>

A. W. F. BANFIELD

*Canadian Wildlife Service, Banff, Alberta.*

**A**N excellent description and an annotated list of the birds of Banff National Park were presented by Clarke and Cowan (1945). Devitt (1947) recorded three additions to this list. The purpose of this paper is to record several additions and changes in status that have been observed during the period of my residence at Banff, since August, 1950.

### ANNOTATED LIST

**Western Grebe.** *Aechmophorus occidentalis* (Lawrence).

A regular and abundant autumn migrant on Third Vermilion Lake and Lake Minnewanka. Earliest date observed, October 8, 1952; latest, November 12, 1950. Flocks of these grebes numbered as many as 63.

**Whistling Swan.** *Olor columbianus* (Ord).

A single whistling swan was observed regularly on Second Vermilion Lake from May 4 to 21, 1951.

**Snow Goose.** *Chen hyperborea* (Pallas).

A single snow goose was observed regularly on First Vermilion Lake from April 22 to May 3, 1952.

**Pintail.** *Anas acuta* Vieillot.

A regular, common, summer visitor to the lower Bow Valley. Earliest date observed, April 11, 1951, at Two Jacks Lake. Latest date observed, October 31, 1952, on First Vermilion Lake.

**Green-winged Teal.** *Anas carolinensis* Gmelin.

Regular, common, summer visitor to the lower Bow Valley. Earliest date observed, April 27, 1951, on the Vermilion Lakes. Latest date observed, September 26, 1950.

**Blue-winged Teal.** *Anas discors* (Linnaeus).

First reported by Devitt (1947). I saw a pair on the Vermilion Lakes on September 21, 1951.

**Shoveller.** *Spatula clypeata* (Linnaeus).

Uncommon summer visitor to the Bow

Valley. First observed April 24, 1952, on Two Jacks Lake.

**Redhead.** *Aythya americana* (Eyton).

A flock of eight was seen on Second Vermilion Lake on April 21, 1951.

**Lesser Scaup.** *Aythya affinis* (Eyton).

A single drake was observed on Horseshoe Lake on April 24, 1951. On April 24, 1952, a pair was seen on Lake Minnewanka.

**White-winged Scoter.** *Melanitta deglandi* (Bonaparte).

A casual migrant. Flocks were seen on Lake Minnewanka on May 17, 1951, and October 15, 1950.

**Hooded Merganser.** *Lophodytes cucullatus* (Linnaeus).

A regular migrant in small numbers near Banff from April 21 to 30, 1951 and 1952.

**Red-breasted Merganser.** *Mergus serrator* (Linnaeus).

Occurs regularly in small numbers in the lower Bow Valley. Earliest date seen, April 22, 1952. Latest date seen, May 9, 1951.

**Greater Yellowlegs.** *Totanus melanoleucus* (Gmelin).

A single bird of this species was observed April 22 to 24, 1952, on the recreation grounds.

**Dowitcher.** *Limnodromus griseus* (Say).

A group of seven dowitchers was seen on September 21, 1951, at First Vermilion Lake.

**Ring-billed Gull.** *Larus delawarensis* Ord.

A pair of adults was observed on First Vermilion Lake on April 27, 1951.

**Bonaparte's Gull.** *Larus philadelphia* (Ord).

First reported by Devitt (op. cit.). A flock of 25 was observed in migration at the park gate on May 3, 1952.

**Short-eared Owl.** *Asio flammeus* (Pontopidan).

Three short-eared owls were observed near Sawback on November 3, 1951.

<sup>1</sup> Received for publication January 21, 1953.

**Belted Kingfisher.** *Megaceryle alcyon* (Linnaeus).

Occasionally kingfishers remain about the Banff fish hatchery late into the winter. Single birds were observed on November 25, 1952, and December 9, 1950.

**Raven.** *Corvus corax* Linnaeus.

Ravens became common winter residents during the elk reduction programs of 1946 and 1947, when they subsisted on the elk offal. In recent years they have become less frequent winter visitors.

**Starling.** *Sturnus vulgaris* Linnaeus.

Since Clarke and Cowan's list was published, starlings have become increasingly common in the lower Bow Valley. A specimen in the Banff Museum was secured in Banff (no date). I have observed these birds on April 21, 1952; May 23, 1951, and November 2, 1951.

**Rusty Blackbird.** *Euphagus carolinus* (Muller).

I have observed these birds at Banff on three occasions: March 26, 1952, October 30, 1951, and November 7, 1951.

**Bronzed Grackle.** *Quiscalis versicolor* Vieillot.

A single bird of this species was seen at Banff on September 26, 1950.

**Hoary Redpoll.** *Acanthis hornemanni* (Coues).

Three hoary redpolls were observed at close range in a flock of common redpolls at Banff on November 15, and 17, 1952.

**Oregon Junco.** *Juncus oreganus* Ridgway.

These juncos are regular spring and autumn migrants in the park. They precede the slate-coloured juncos. Earliest date of arrival, April 1, 1951; latest date of departure, November 17, 1952.

**Tree Sparrow.** *Spizella arborea* (Wilson).

These sparrows are sporadic migrants in the lower Bow Valley. First seen on April 13, 1952. They are more common in autumn. They appeared in large numbers between October 31 and November 2, 1951.

**Lapland Longspur.** *Calcarius lapponicus* Linnaeus.

Longspurs are sporadic autumn migrants in the Bow Valley, occasionally appearing in large flocks. The earliest date of observation was September 13, 1951, and the latest, November 15, 1952.

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## NOTES AND OBSERVATIONS

### Breeding-Bird Census 1952

**Location:** Estate of the late W. L. Mackenzie King, Kingsmere, Quebec.

**Size:** 75,625 square yards, (approx. 15 acres).

**Description:** A typical Gatineau deciduous woodland, somewhat disturbed. Square plot located largely on a hill-top. Land at the south boundary dropping sharply to the main stream of the area. A broad walking path parallel to the south boundary just beyond the stream. Land at the north sloping suddenly to a small swamp. Land on the east dropping sharply to a small tributary stream. A deep valley and stream traversing the plot near the west boundary, the stream spreading to a swampy grove at the south-west corner and joining the main stream beyond. The

ground generally high and rocky. Two small ponds within the plot, one permanent, the other dry in early summer. Dominant trees beech and maple, mixed mature and immature, mostly with high crowns. Few small clearings and one area of maple sapling growth. Occasional ironwood, basswood, and white birch. Ground cover sparse, typical of beech-maple forest. Surrounding area similar for not less than 250 yards on all sides.

**Coverage:** May 18 to July 6 inclusive; 12 visits totalling 45 hours. Hours varied from 7.15 A.M. to 9.30 P.M. Usually only one observer.

**Census:** (Actual numbers of breeding pairs and in parentheses number of pairs per 100 acres). Least Flycatcher 3 (20); Ovenbird 2 (13); Red-eyed Vireo 2 (13); Wood Pewee

1 (7); Yellow-bellied Sapsucker 1 (7); Rose-breasted Grosbeak 1 (7); Olive-backed Thrush 1 (7); Veery 1 (7); Hairy Woodpecker 1 (7). Total pairs 13 per 15 acres, (87 per 100 acres).

Visitors: (Bird pairs frequently seen on the plot, obviously nesting in the vicinity but not within plot limits). Hermit Thrush 1, Wood Thrush 1, Blackburnian Warbler 1, Black-throated Green Warbler 1, Redstart 1, Cooper's Hawk 1, Barred Owl 1, Scarlet Tanager 1, Crested Flycatcher 1. Other species seen in the area but never on the plot, Pileated Woodpecker, Downy Woodpecker, and White-throated Sparrow.

Remarks: Majority of birds nesting high in trees, even those normally near ground.

J. W. ARNOLD, *Ottawa*

**MATING of the RED-NECKED GREBE,** *Colymbus grisegena* Boddaert. — On May 18, 1952, while observing some ducks on a small lake in the Kootenay Valley, a few miles north of Cranbrook, B.C., the writer's attention was drawn to the activities of a pair of Red-necked Grebe. Both birds were obviously in a state of great excitement, frequently submerging for short durations, coming together, bobbing heads and occasionally touching beaks.

Surfacing after a dive, one of the pair proffered the other a gift, which appeared to be a small portion of water weed, this was accepted and swallowed. Immediately following, both birds, one close behind the other, started swimming towards a small island, from the shore of which there projected, almost horizontally into the water, the bole of a fallen yellow pine, the diameter of which was approximately twelve inches where it made contact with the water. The grebe that was ahead, on reaching the fallen pine, slid up the tree for about two feet from the point where it was totally submerged, came to rest lying flat on its breast with neck out-stretched and the posterior slightly elevated; its mate immediately followed up the tree and reared up to take an almost vertical stance, seemingly using the posterior and legs for support, made contact and coition took place, lasting for ten to fifteen seconds, then both birds slid into the water and commenced preening. According to Jourdain and Ticehurst (Handbook of British Birds, 1940, Vol. 4, p. 94) coition is usually on the nest (or nest platform) as in other grebes.

WALTER B. JOHNSTONE,  
*Cranbrook, British Columbia.*

**Gavia adamsi on Devon Island.**—Constable Donald Nelson, R.C.M.P., has forwarded to the Royal Ontario Museum the skull of a loon found at Dundas Harbour, Devon Island, in 1949. The specimen, No. 76508, is of the form *Gavia adamsi*, and represents a mature example. This constitutes a considerable northeastward extension of range within the Canadian Arctic though probably occurrence beyond the limits marked by the Boothia Peninsula is more or less casual. — L. L. SNYDER, *Royal Ontario Museum of Zoology and Palaeontology, Toronto.*

**Northern swamp tree frog, *Pseudacris nigrita septentrionalis* (Boulenger) from Churchill, Manitoba.** — On 30 July, 1952, the author accompanied by Harold E. Welch found an adult northern swamp tree frog, *Pseudacris nigrita septentrionalis* (Boulenger) at Landing Lake near Churchill, Manitoba. Subsequently, on 12, 15 and 16 August, 1952, while engaged in field work for the Defence Research Board, C. A. Barlow and the author collected three more specimens — all small, recently transformed individuals.

These four specimens apparently are the first of the species to be recorded from the Churchill region, although the occurrence of *P. n. septentrionalis* in this part of northern Manitoba was not altogether unexpected. Logier (1952) states that the range of this subspecies is: 'From Minnesota and northern and western Ontario to the Canadian Northwest Territories and the Peace River District of British Columbia.'

Although many naturalists and professional biologists have carried out active field work in the Churchill region, no report of the presence of the swamp tree frog has hitherto been published. Indeed, on the basis of extensive field studies at Churchill, Sheldford and Twomey (1941) state that, 'The northern frog is the only tailless amphibian...' in the vicinity of Churchill, Man. (They elsewhere refer to the 'northern frog' as *Rana cantabrigensis latiremis* (S and B), which species Logier (1952) considers synonymous with the wood frog, *R. sylvatica* Le Conte.)

The Landing Lake area from which all our specimens were collected lies several miles to the south of the townsite of Churchill. Here the great boreal forest of the south and west grades into the strip of flat tundra which occupies most of the Hudson Bay coastal area. Numerous small, sedge-bordered ponds, and hummocks of lichens and heaths cover most of the area. On this tundra,

scattered groups of stunted larches and white spruces are interspersed with a few scrubby willows and dwarf birches.

Our specimens were collected in or near water in this open forest-tundra transition zone. The first was found on the side of a *Cladonia*-heath hummock, just one inch above the water level of a sedgy pond. The second was swimming in another small pool. Both the third and fourth were found on the tundra within a few feet of water.

Each specimen had a dark lateral band from the snout through the eye and posteriorly along the side. Each one had a slightly pebbled, creamy-white belly, and dull green legs with darker blotches. The ground colour and stripes of the dorsal surface of the body exhibited the most variation. The largest specimen, which in life measured 30 mm. in head-body length, was grass green with pearly grey stripes. The first young individual, taken 12 August, was 15 mm. long; it had not fully resorbed the larval tail. Its colour was dull green with grey stripes. The other two immature specimens were dull green with grass green stripes.

The first specimen captured was kept in the laboratory for a week and was fed small flies which it ate readily. To our great disappointment it disappeared mysteriously and was not relocated. However, the three young specimens were preserved and have been deposited in the collection of the Royal Ontario Museum of Zoology and Palaeontology.

Acknowledgement is hereby made to the Defence Research Northern Laboratory under whose auspices the field work was carried out, and to the Defence Research Board for permission to publish this paper.

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 DONALD A. SMITH,  
*Department of Zoology, University of Toronto, Toronto 5, Ontario.*

**The European Praying Mantis, *Mantis religiosa* L., at London, Ontario.** — The distribution of *Mantis religiosa* L. in Ontario has been studied by Urquhart and Corfe (1940), James (1949) and Judd (1947, 1950) who show that this insect has been steadily increasing its range westward from counties

north of Lake Ontario into southwestern Ontario. James (1949) plotted on a map the distribution of *M. religiosa*, using records up to the year 1948, and showed that this species had ranged as far westward as a line joining Goderich (Huron Co.) on the north and Simcoe (Norfolk Co.) on the south. The following records of collections at London, Ontario show that *M. religiosa* was present in Middlesex County at least as early as the fall of 1950: green ♀, Sept. 9, 1950; green ♀, August 12, 1952; brown ♀, Aug., 1952; green ♀, Sept. 1, 1952; green ♀, Sept., 1952. The specimens were collected by citizens of London in backyards, on lawns and in a railway yard in the city and are deposited in the collections of the University of Western Ontario.

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—W. W. JUDD,  
*Department of Zoology, University of Western Ontario, London, Ontario*

**International Ornithological Congress.** — The 11th International Ornithological Congress will be held in Basel, Switzerland, from May 29 to June 5, 1954. During the week of the Congress, five days will be devoted to meetings and two to excursions. Before and after the Congress (May 25-28 and June 7-19), excursions will be arranged to enable members to become acquainted with the Swiss avifauna, especially of the Alps and Lower Alps. The Congress fee is thirty Swiss francs.

The prospectus, containing registration form and detailed information, will be distributed shortly. Applications to attend, and to contribute scientific papers, should be sent in before February 28, 1954 and addressed to:  
**11th International Ornithological Congress,  
 Zoological Garden,  
 Basel, Switzerland.**

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\* \* \*

*The Annual Meeting of the Ottawa Field-Naturalists' Club will be held at 8 p.m., December 3, 1953, in the Auditorium, Carleton College, Ottawa, Ontario.*

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